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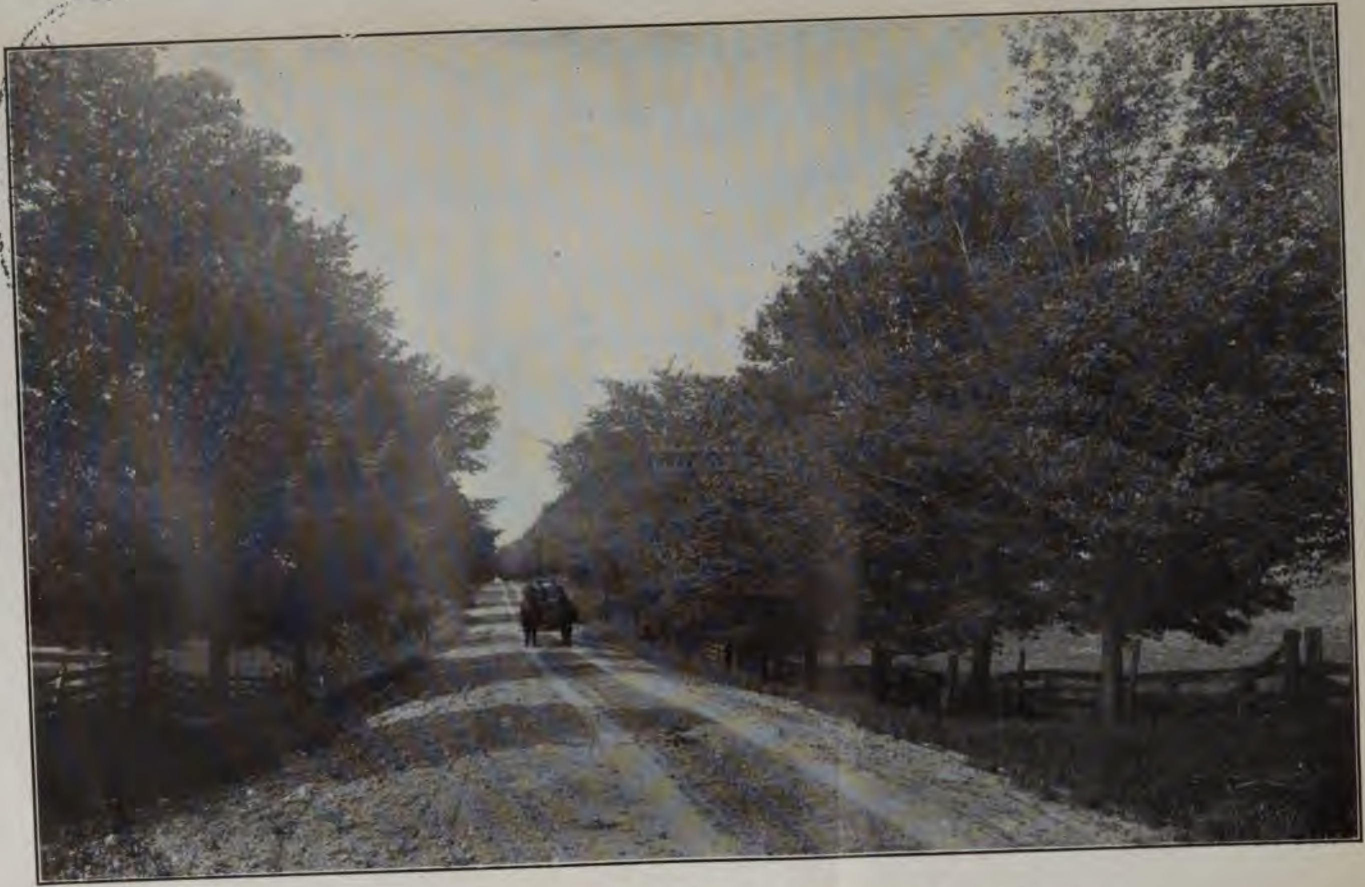

Fourteen foot gravel road built by the Grand Traverse Road Commission in Garfield Township.

STATE OF MICHIGAN

FIFTH BIENNIAL REPORT

OF THE

STATE HIGHWAY COMMISSIONER

FOR TWO FISCAL YEARS

Ending June 30, 1914.

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LETTER OF TRANSMITTAL.

Honorable Woodbridge N. Ferris,
Governor:

In compliance with section 2, Chapter 5, Act 283, Laws of 1909, I have the honor to submit the fifth biennial report of the Michigan State Highway Department.

Very respectfully,
FRANK F. ROGERS,
State Highway Commissioner.

June 30th, 1914.

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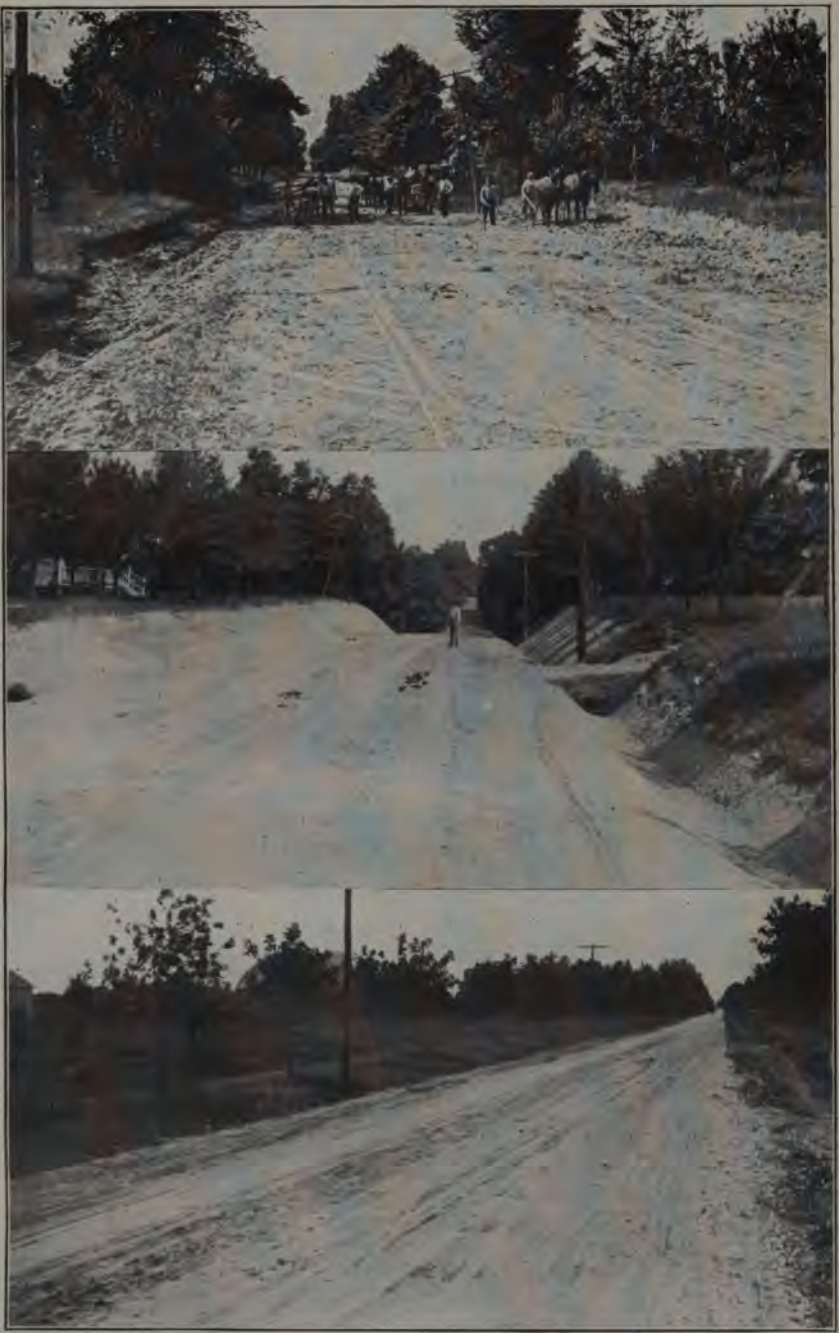
South Haven township, Van Buren county 16-foot macadam road....Opposite page 6
Thornapple River bridge, Caledonia township, Kent county.........Opposite page 12

STATE HIGHWAY COMMISSIONERS OF MICHIGAN.

Department created by Public Act 146, 1905.

Honorable Horatio S. Earle, 1905-1909	Detroit
Honorable Townsend A. Ely, 1909-1913	Alma
Honorable Frank F. Rogers, Elected, July, 1913	Lansing



These views show grading operations, finished grade, and finished macadam 16-ft. trunk line road in South Haven township, Van Buren county, being constructed by the Township. Take note of the carefully trimmed banks to 1½ to 1 slope, the driveway approaches across the ditches, etc.

TABLE NO. 1.—*Michigan's Road Taxes 1901-1913.*

Year.	Township Road Tax.	County Road Tax.	State Reward Tax.	Total.
1901	$2,253,039 48	$166,471 76		$2,419,511 24
1902	2,462,816 29	179,826 45		2,642,642 74
1903	2,600,727 04	239,031 58		2,839,758 62
1904	2,937,215 69	266,555 79		3,203,771 48
1905	2,976,077 47	285,963 80	$30,000 00	3,292,041 27
1906	2,988,989 17	420,321 10	60,000 00	3,469,310 27
1907	3,091,647 59	421,307 07	110,000 00	3,622,954 66
1908	2,916,817 01	529,452 45	160,000 00	3,606,269 46
1909	3,014,344 94	741,868 05	150,000 00	3,906,212 99
1910	3,264,049 30	859,157 50	150,000 00	4,273,206 80
1911	3,448,309 37	815,227 24	245,000 00	4,508,536 61
1912	3,845,834 89	1,308,043 13	245,000 00	5,398,878 02
1913	4,336,029 57	1,621,681 34	800,000 00	6,757,710 91
Total	$40,135,897 81	$7,854,907 26	$1,950,000 00	$49,940,805 07

SUMMARY OF WORK OF STATE HIGHWAY DEPARTMENT COVERED BY THIS REPORT.

During the first year, Hon. Townsend A. Ely was commissioner, and during the second year, the writer, who had previously served as deputy commissioner for eight years, was at the head of the department.

The first year saw but few changes in the kind and character of the work from that of former years, and was mainly notable for the rapid increase in the mileage of state rewarded roads. Five hundred twenty-three miles of road were accepted for state reward, making a grand total of 1,754 miles on June 30th, 1913. In other words, nearly 30% of all the roads, which had been built for state aid in the past eight years, were constructed during this year.

The entire working force of the department up to near the close of that year consisted of the commissioner, his deputy (civil engineer), two engineer-inspectors and a stenographer. The second, or last fiscal year, covered by this report marks a vast change in the kind and amount of work performed, due partly to amendments to the former state reward road law, but mainly to the passage of the so-called "Trunk Line Act."

CHANGES IN LAW.

The amendments, referred to, are as follows:

Extra state reward for increased width of paved roadways between nine and sixteen feet, based on an increase of ten per cent for each added foot in width between the dimensions above named. Heretofore, all rewards had been the same, regardless of the width of paved roadway, viz.: $250, $500, $750 and $1,000 per mile. Now, a gravel road, built sixteen feet wide, may draw a reward of $850 per mile, and a macadam, concrete or brick road, sixteen feet wide, may draw a reward of $1,700 per mile. See Section 10, State Reward Road law, page 38.

This change has been of great benefit and is appreciated by those localities near large cities, which necessarily pay a large percentage of the State taxes and have to build the wider roads to accommodate a large volume of traffic.

The other change is a provision for a small State maintenance or repair fund, based on two per cent of the rewards earned, and payable annually after the first of December, providing the repairs are made under specifications prepared by or approved by the State Highway Commissioner. See Section 16, State Reward Road law, page 42.

The requirements laid down by the State Highway Commissioner for earning this repair fund will be found on page 84. $13,012.38 were paid out for maintenance the first year out of a possible $21,395.36 had all of the roads qualified for the State repair money. It is expected that next year a much larger percentage of townships and counties will avail themselves of this liberal proposition on the part of the State.

Act No. 334, Public Acts of 1913, commonly known as the "Trunk Line Highway Act," made necessary a large increase in the working force of the department. This Act is printed in full on page 42. It provides for the locating of about 3,000 miles of trunk line highways in the State, which are, in a general way, defined by naming the cities and villages along the routes, but, for the most part, the exact lines to be followed between the towns have to be agreed upon by the local authorities and determined by the State Highway Commissioner after making such preliminary examinations and surveys as he deems necessary.

A restrictive clause limits the number of miles of trunk line highways that may be rewarded in any county to three miles for each surveyed township, fractional townships counting pro rata. It was at first supposed that counties, in which the full quota of miles was not laid out by the legislature, could elect, through the co-operation of the State Highway Commissioner, enough miles of trunk lines to cover the deficiency, and that such counties as Branch, Cass and Luce, in which no trunk lines were laid out at all, might elect the whole milage. The Supreme Court, however, held this to be illegal, and the next legislature should take steps to remedy this discrimination and give each county its full pro rata of trunk lines either in continuous lines, connecting at both ends with other trunk lines already established, or as important branches connecting with other trunk lines. I believe that such a change would make this feature of the trunk line act satisfactory to most communities, and it surely would be fair to every county in the State.

The trunk line act does not compel the building of these roads at any specified time, or even at all, but simply provides for the double rewards on the different classes of roads of various widths, thus making rewards on the trunk lines range from $500 per mile on the sand-clay road, nine feet wide, to $3,400 per mile on the macadam, concrete or brick road

The above shows two views of the Carp River bridge on the trunk line in Emmet county, Michigan. This bridge was built by the State Highway Department. Standard I-beam construction, with reinforced concrete floor and rails.

For contract price and other details, see Trunk Line Bridge Table, Contract Number 10, on page 100.

which is to be built sixteen feet wide. The former road, "Class A," is allowed and recommended in some sparsely settled sections, but the better roads and greater widths are recommended wherever the travel is heavy and the community able to build the higher type of road. I am fully convinced that no one kind of road is adapted to all soil and traffic conditions, and am endeavoring to recommend roads which shall meet the traffic requirements and at the same time not cost more than the township or county can afford.

That this law has not stopped the building of ordinary reward roads will be noted from the fact that only 45 miles of trunk line roads were rewarded last year out of a total of 689 miles. The grand total of state rewarded roads on June 30th, 1914, was 2,436½ miles.

The trunk line act provides for the payment of an additional 50% reward on old state rewarded roads, which were in perfect repair and which happened to fall upon the trunk lines $58,778 were paid on 136.648 miles of such road during the last fiscal year.

TRUNK LINE BRIDGES.

This law further provides that the State shall design and build all bridges of more than 30 foot clear span on the trunk lines, providing the township or county has funds available and agrees to build three miles of trunk line road, which includes the bridge. Up to July first, contracts had been let for trunk line bridges as shown by table on page 100.

I am of the opinion that this is one of the most valuable features of the law, as it has served as an object lesson by showing what can be accomplished in the way of buying well designed highway bridges at reasonable costs when the whole matter is handled purely as a business proposition.

Mr. C. V. Dewart, a graduate civil engineer and formerly Assistant Bridge Engineer for the Pere Marquette Railroad, was placed in charge of the bridge department and deserves much credit for helping to organize it along purely scientific and business lines. Standard plans have been designed for all short span culverts and bridges, cuts of which may be seen on page 100. Large scale blue prints may be obtained, without cost, by any township or county road commissioner upon application to the State Highway Department.

As an example of what may be saved by the use of such plans, I might say that the State contracted for plain rolled I-beams for all bridges to be built during the season of 1914 at $1.20 per 100 pounds at the mills. With freight added, the prices have ranged from $1.46 to $1.87 per 100 pounds f. o. b. nearest railroad siding to the various bridge locations, which is less than one-half what the average township or county has paid for similar material in the manner in which it is ordinarily bought.

Corresponding savings have been made on large bridges, by taking separate bids on foundation and superstructure. A notable example is the Saranac bridge, which was handled by this department for Boston township, Ionia county, under the provisions of Section 3, Chapter XII, of the Highway Laws, where $2,000 were saved the township and a better bridge secured than the township was able to get under old methods.

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Pictures of the old and new bridges may be seen on page 60.

The Attorney General has ruled that the State shall maintain the bridges it builds, but cannot repair old bridges under this act. The section giving the State power to build trunk line bridges should be amended so as to give power to repair old bridges. Many old bridges might have their lives greatly prolonged if the department had power to make such repairs as putting in new foundations, building new floors, etc.

PRELIMINARY SURVEYS AND PLANS.

Preliminary surveys were made of 1,200 miles of road to determine the best location for trunk lines. The total cost of such surveys is $3,269.40, or only $2.72 per mile. This cost would not be as much except for the prime meridian, which for the most part traverses rough cut-over lands, more or less covered with brush, on which the survey cost $3.50 per mile. The prime meridian was surveyed from a point between Merrill and Wheeler north to intersect with the Huron Shore trunk line in Cheboygan county, a distance of 150 miles. A general report of this survey will be found on page 114. On these preliminary surveys, the following information was obtained, and when any controversey has arisen, the lines have been fully mapped.

(1) Character of country traversed; timber, cut-over lands—character of stumps; clearing; improved farms.

(2) Approximate location of buildings—kind.

(3) Condition of road grade, if any: (a) approximate width; (b) alignments; (c) drainage.

(4) Kind of soil on roadway (a) sand; (b) clay, (c) loam; (d) swamp.

(5) Location, condition and size of ditches, creeks and streams that must serve as outlets for water from the roadway.

(6) Condition of, location of and measure of present culverts and bridges.

(7) Photographs of all truss bridges and others that might need to be repaired or rebuilt.

(8) Bearings of roads traversed with compass.

(9) Intersections with corporate limits of cities and villages.

(10) Slope, length and height of hills where grade exceeds 5%.

(11) On traveled roads, number and kind of vehicles passed so as to form some estimate of public traffic.

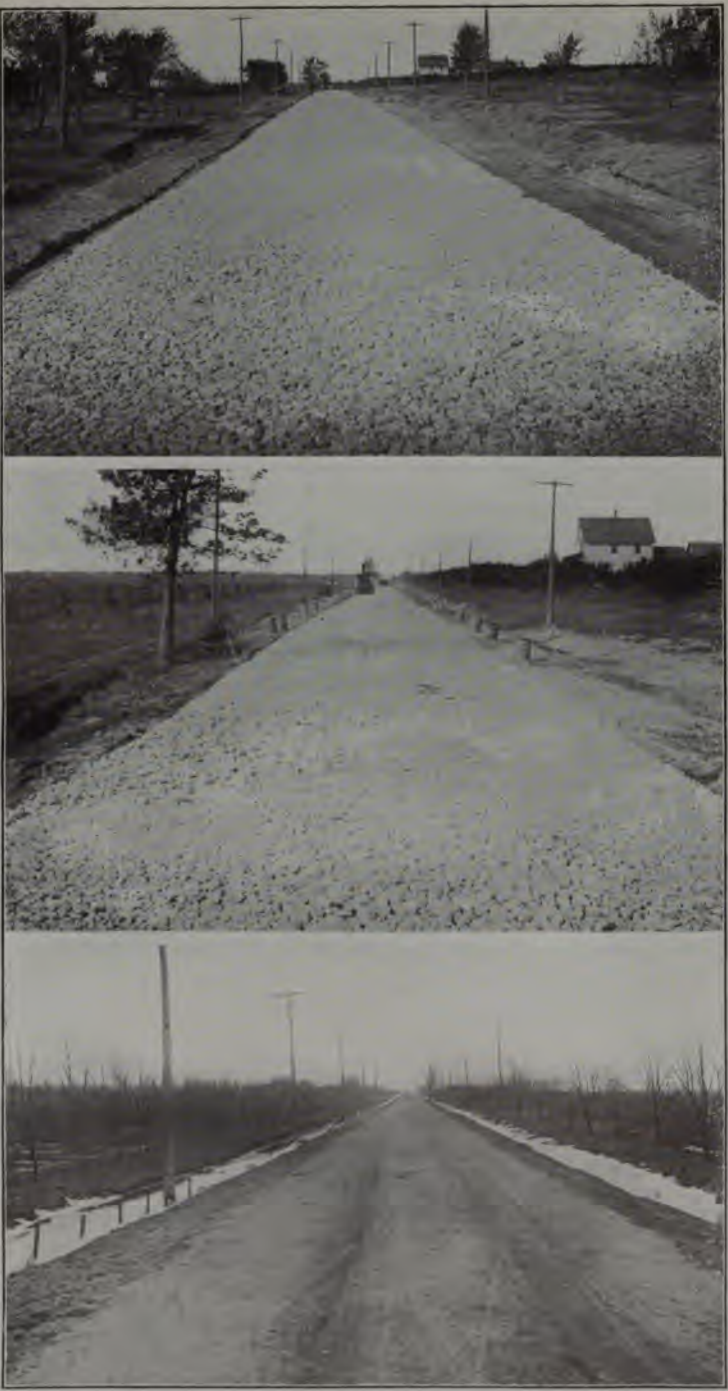
(12) Notes as to available road material, gravel, stone, etc.

(13) Approximate estimate of cost of grading per mile.

LOCATION SURVEYS.

Complete location surveys and plans were made for 299.451 miles of trunk lines, at a total cost of $12,039.69, or $41.60 per mile. An examination of the profile on page 51 will show the amount of information secured and placed on these plans. It is so much more than is secured by the ordinary surveyors that the writer thinks the cost exceedingly low, and is convinced that it is entirely practicable to undertake the surveying of roads in any part of Michigan when occasion demands.

I should not close without expressing grateful appreciation of the



Sixteen foot macadam road in Covert Twp., Van Buren County, built by the township commissioner. Upper view shows the loose stone on the bottom course, having been dry rolled, screening not yet on. Middle view shows the same road after the top course has been applied and some screenings added. Bottom view shows a completed section of the road after travel has started.

co-operation of all of the State Departments, especially Governor Ferris, the Attorney General, the Auditor General and the Board of State Auditors, all of whom we have been obliged to call upon for many favors. My deputy, Mr. L. C. Smith, and all the employees have worked untiringly, and one-half hour longer each day than most State Departments without complaint. All deserve credit for rendering efficient and faithful public service.

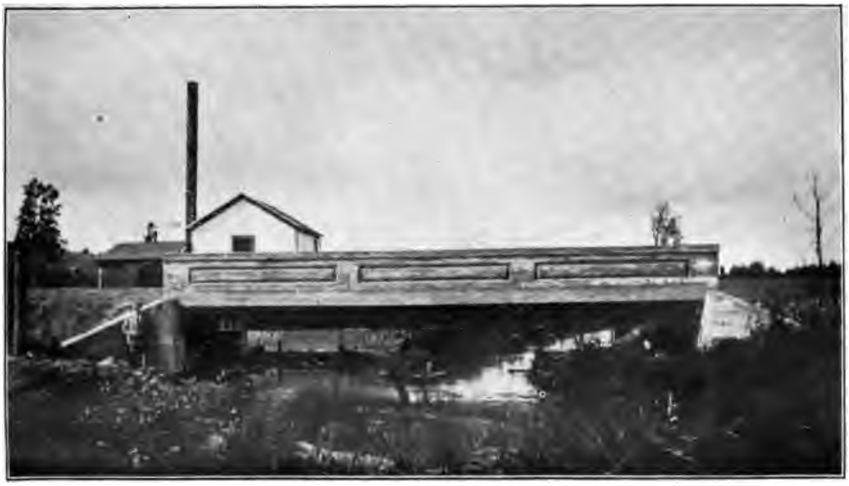
FRANK F. ROGERS,
State Highway Commissioner.

TABLE NO. 2.—*Departmental receipts and expenditures for fiscal year ending June 30, 1913.*

	Expenditures.	Receipts.
Current expense fund balance from 1912, fiscal year		$29 03
Appropriation for 1913, fiscal year		10,000 00
Deficiency appropriation of 1913		1,500 00
Drawn from motor vehicle fund		4,280 24
Salaries and per diem (See Table 3)	$10,192 61	
Traveling expenses and help	2,908 88	
Reports, bulletins, postage and other publicity	1,774 39	
Equipment for office and field work	465 17	
Engineers' supplies	79 38	
Stationery and office supplies	311 10	
Sundries, telegraph, telephone, express, freight, cartage, etc.	77 74	
	$15,809 27	$15,809 27

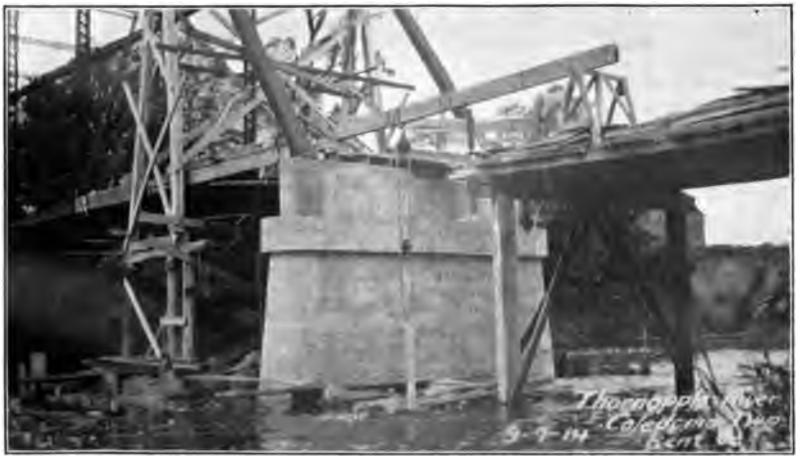
TABLE NO. 3.—*Salaries and per diem of employees of State Highway Department for fiscal year ending June 30, 1913.*

State Highway Commissioner, Townsend A. Ely	$2,500 00
Deputy Highway Commissioner, Frank F. Rogers	1,800 00
Office Engineer, Leroy C. Smith	1,516 70
Engineer, William W. Cox	1,420 88
Engineer, W. J. Baumgrass	552 70
Engineer, L. H. Neilsen	453 60
Engineer, K. I. Sawyer	264 64
Engineer, E. W. Muenscher	95 00
Engineer, G. V. Carpenter	10 00
Engineer, R. Martin	5 00
Draftsman, H. L. Brightman	113 39
Draftsman, L. B. Westerman	66 76
Accountant, Chas. S. Emery	126 39
Clerk, D. G. Brown	343 24
Clerk, I. B. Smith	72 00
Stenographer and Clerk, W. I. McCarthy	841 76
Stenographer, Ruth Ryan	10 55
Total salaries and per diem	$10,192 61



42 foot trunk line bridge in Wakefield township, Gogebic county. This bridge is heavy I-beam construction, with reinforced concrete slab floor and rails. Gogebic county applied for the trunk line road, including this bridge site, about the middle of April, 1914, and requested the construction of bridge as soon as possible. This department advertised for the work, let the contract and had the job all finished by July 1st, 1914.

For details as to contract price, etc., see Trunk Line Bridge Table, Contract Number 15, on page 100.



This view shows completed concrete pier, built by contract, for Caledonia Township Board, Kent county. A new steel truss of 120 foot span is still to be placed. The work is being done under the supervision of the State Highway Department.

For details as to contract price, etc., see Trunk Line Table, page 100.

TABLE NO. 4.—*Departmental receipts and expenditures for fiscal year ending June 30, 1914.*

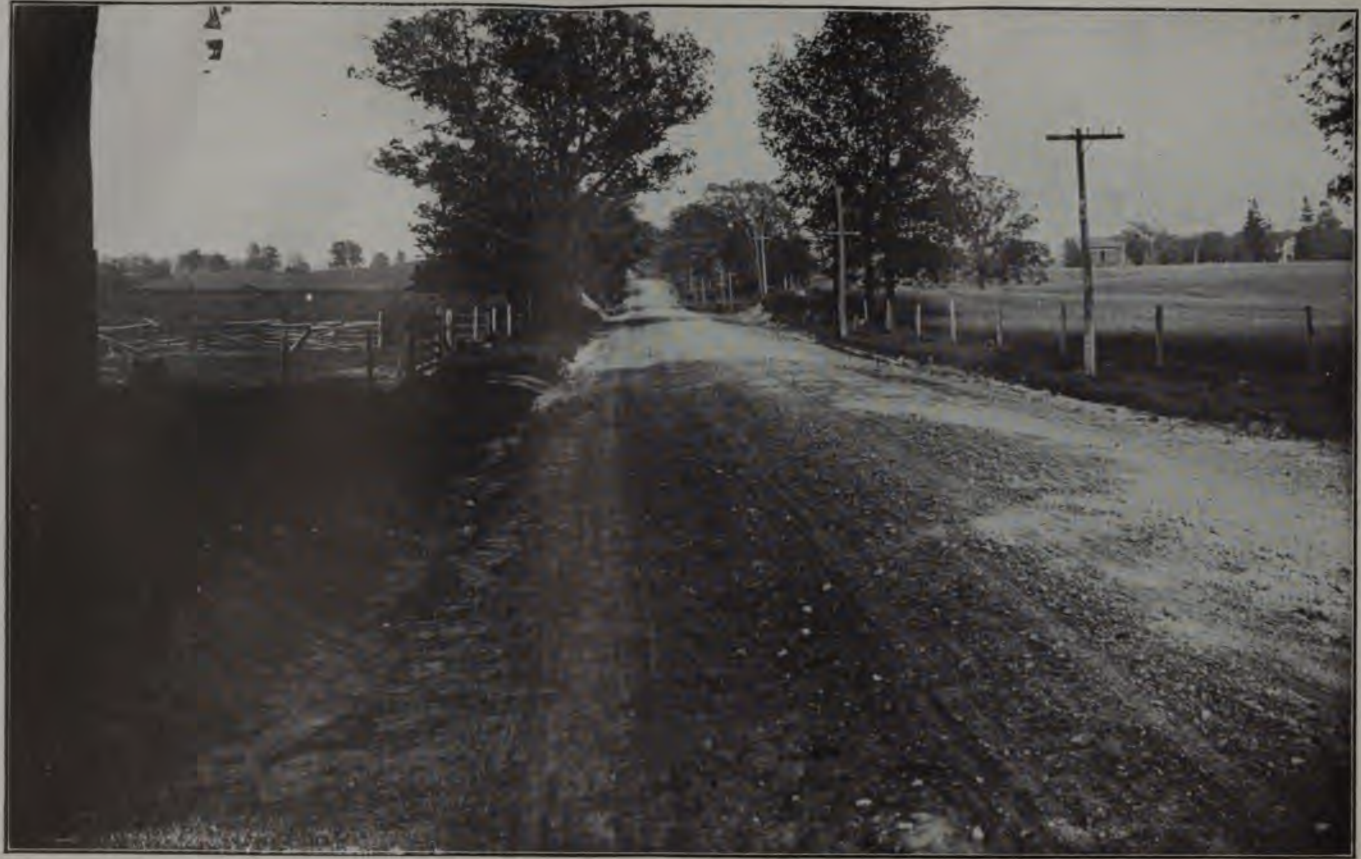
	Expenditures.	Receipts.
Appropriation for 1914, fiscal year		$18,000 00
Drain refund (Section 2, 4, 8, Chap. 7, Act No. 185, Public Acts 1911):		
Calhoun-Eaton		32 39
Clinton-Ingham		15 00
Bay-Midland		14 44
Drawn from Motor Vehicle Fund		1,882 03
Salaries and per diem (See Table 5)	$13,233 15	
Traveling expenses and help	4,563 89	
Reports, bulletins, postage and other publicity	1,058 91	
Equipment for office and field work	274 60	
Engineers' supplies	37 61	
Stationery and office supplies	519 00	
Sundries, telegraph, telephone, express, freight, etc	256 70	
	$19,943 86	$19,943 86

TABLE NO. 5.—*Salaries and per diem of employees of State Highway Department for fiscal year ending June 30, 1914.*

State Highway Commissioner, Frank F. Rogers	$2,500 00
Deputy Highway Commissioner, Leroy C. Smith	1,974 95
District Engineer, Wm. W. Cox	1,700 00
District Engineer, L. H. Neilsen	1,533 60
District Engineer, K. I. Sawyer	1,516 70
District Engineer, R. W. Roberts	798 00
Engineer, G. V. Carpenter	18 00
Clerk, D. G. Brown	188 28
Inspector, R. D. O'Keefe	375 00
Office Engineer, W. S. Cumming	213 62
Accountant, Chas. S. Emery	1,000 00
Clerk, Clara Rogers	250 87
Clerk and Stenographer, W. I. McCarthy	1,000 00
Messenger, Fred Rogers	150 97
Messenger, John Rich	13 16
Total salaries and per diem	$13,233 15

TABLE NO. 6.—*Receipts and Expenditures of Trunk Line Fund for fiscal year ending June 30, 1914.*

		Expenditures.	Receipts.
Appropriation for 1914, fiscal year			$200,000 00
From Kent County for wider Plaster Creek Bridge			900 00
General Office Expense:			
Salaries (See Table 7)	$2,987 84		
Traveling expenses	89 09		
Equipment	154 04		
Stationery and supplies	326 28		
Reports, bulletins, etc	7 83		
Sundries and liability insurance	130 88		
Total		$3,695 96	
Preliminary Surveys:			
Salaries (See Table 7)	$2,000 95		
Helpers and travel expenses	1,158 05		
Equipment	63 80		
Supplies	46 60		
Total		3,269 40	
Surveys, Plans and Maps:			
Salaries (See Table 7)	$8,094 51		
Helpers and travel expenses	9,709 96		
Equipment	777 24		
Supplies	1,242 51		
Total		19,824 22	
Bridges:			
Salaries (See Table 7)	$4,465 96		
Travel, tests, proposal advertisements	1,671 89		
Equipment	546 41		
Construction	21,347 67		
Supplies	95 57		
Total		28,127 50	
Trunk Line Road Rewards:			
New	$57,085 00		
Rebuilt	1,780 00		
Fifty per cent additional	58,778 00		
Total		117,643 00	
Total expenditures		$172,560 08	
Balance to 1915, fiscal year		28,339 92	
		$200,900 00	$200,900 00



Nine foot gravel road construction by the township commissioner of Parma township, Jackson county. A few large stones had not been removed from the surface at the time the photograph was taken.

TABLE NO. 7.—*Salaries and per diem of trunk line employees of State Highway Department for fiscal year ending June 30, 1914.*

General Office Expense:		
R. D. O'Keefe, Inspector	$1,092 39	
C. J. Neal, Draftsman	778 40	
L. H. Belknap, Engineer	31 25	
C. B. Purcell, Stenographer	598 80	
Ruth Ryan, Stenographer	475 00	
Marjorie Heil, Stenographer	12 00	
Total		$2,987 84
Preliminary Surveys:		
L. D. Townsend, Engineer	$1,202 50	
L. H. Belknap, Engineer	497 95	
D. A. Brotherton, Engineer	237 50	
R. W. Roberts, Engineer	63 00	
Total		2,000 95
Surveys, Plans and Maps:		
L. H. Belknap, Locating Engineer	$889 50	
L. D. Townsend, Locating Engineer	441 70	
H. L. Brightman, Chief Draftsman	1,250 00	
G. C. Dillman, Draftsman	898 86	
E. D. Kingman, Draftsman	180 60	
M. De Glopper, Draftsman	621 24	
E. K. Lovelace, Draftsman	708 60	
L. B. Westerman, Draftsman	663 33	
C. D. Curtiss, Draftsman	379 71	
C. E. Foster, Draftsman	520 57	
C. S. Roe, Draftsman	149 20	
John Dennis, Draftsman	372 50	
R. W. Newton, Draftsman	130 59	
M. C. Hengst, Draftsman	19 30	
U. C. Zeluff, Draftsman	6 36	
M. L. Moone, Draftsman	17 76	
N. B. Gridley, Draftsman	5 00	
C. C. Cox, Surveyor	307 18	
T. R. Shaver, Surveyor	117 95	
W. Willitts, Surveyor	238 00	
R. J. Robb, Surveyor	60 00	
E. W. Muenscher, Engineer	5 00	
D. D. Worcester, Engineer	55 00	
W. J. Lehner, Engineer	20 00	
Lee Stockman, Rodman	21 76	
Fred Rogers, Rodman	14 80	
Total		8,094 51
Bridges:		
C. V. Dewart, Bridge Engineer	$1,840 10	
E. H. Shuttleworth, Bridge Draftsman	894 90	
H. M. Wood, Bridge Inspector	664 07	
C. S. Roe, Bridge Inspector	646 32	
L. B. Westerman, Bridge Inspector	266 67	
H. F. Beyer, Bridge Inspector	60 64	
R. W. Newton, Bridge Inspector	29 63	
C. E. Foster, Bridge Inspector	23 59	
W. J. Howard, Bridge Inspector	20 74	
Chas. L. Carter, Bridge Inspector	19 30	
Total		4,465 96
Grand total Trunk Line, salaries and per diem		$17,549 26

TABLE NO. 8.—*Showing Summary by counties for fiscal*

Note three lines of figures for each county.

Name of county.	Accepted applications in miles by classes.					
	A.	B.	C.	D.	E.	F.
Alger					8.551	
					8.551	
Allegan		.996	2.799		2.000	
	.800				2.608	
	.800	.996	2.799		4.608	
Antrim		44.005		5.667	2.355	
		6.750				
		50.755		5.667	2.355	
Arenac		1.010				
		1.010				
Baraga		1.000				
		—1.000				
Barry		24.773				
		8.861				
		33.634				
Bay	.997		.998		48.805	.161
		2.996	1.000		7.106	
	.997	2.996	1.998		55.911	.161
Benzie		29.420				
		35.096				
		64.516				
Berrien		7.881	1.746		39.065	
	.250	1.571		5.865	2.321	2.000
	.250	9.452	1.746	5.865	41.386	2.000
Branch		24.459				
		22.066				
		46.525				
Calhoun		50.121			7.566	
		43.890			4.096	
		94.011			11.662	
Cass		14.010				
		5.962				
		19.972				
Charlevoix		5.919				
		1,850			5.420	
		7.769			5.420	
Cheboygan		6.856	2.640	1.515	10.780	
		1,458	—.010		3.062	
		8.314	2.630	1.515	13.842	
Clare	1.494	13.973				
		3.000				
	1.494	16.973				
Clinton						
		3.010				
		3.010				
Crawford		6.960	5.595			
		3.088	1.059		1.238	
		10.048	6.654		1.238	
Delta					60.862	
					5.291	
					66.153	
Dickinson					14.969	
					.607	
					15.576	
Eaton		33.799				
		33.166				
		66.965				

year, July 1, 1912, up to close of day June 30, 1913.

Line 1.—Totals to July 1, 1912.
Line 2.—Business of fiscal year.
Line 3.—Totals close of day, June 30, 1913.

Miles of road built by classes.						Reward paid to—	
A.	B.	C.	D.	E.	F.	Counties.	Townships.
				8.551		$8,551 00	
				8.551		8,551 00	
	.500	1.503		1.000			$2,377 00
.800		1.000		1.814			2,765 00
.800	.500	2.503		2.814			5,142 00
	29.182		4.663				$18,087 00
	6.239						3,119 00
	35.421		4.663				21,206 00
	1.010						$505 00
	1.010						505 00
	15.742						$7,871 00
	7.144						3,572 00
	22.886						11,443 00
				38.160		$38,160 00	
				10.628	.161	10,789 00	
				48.788	.161	48,949 00	
	18.969						$9,484 00
	8.311						4,156 00
	27.280						13,640 00
	3,516	1.000		12.936			$15,444 00
.250	.125		2.375	10.427	.889	$6,924 00	6,298 00
.250	3.641	1.000	2.375	23.363	.889	6,924 00	21,742 00
	10.832						$5,416 00
	4.056						2,028 00
	14.888						7,444 00
	28.013			5.037			$19,044 00
	15.770			1.413			9,298 00
	43.783			6.450			28,342 00
	10.506						$5,253 00
	6.962						3,481 00
	17.468						8,734 00
	1.475						$738 00
	2.016						1,008 00
	3.491						1,746 00
	2.576	2.630	1.515	4.119		$8,516 00	
				3.833		3,833 00	
	2.576	2.630	1.515	7.952		12,349 00	
1.000	7.051						$3,775 00
	2.680						1,340 00
1.000	9.731						5,115 00
	4.852	2.223					$4,093 00
	2.072	2.071					2,589 00
	6.924	4.294					6,682 00
				34.243		$27,124 00	$7,119 00
				5.204		4,813 00	391 00
				39.447		31,937 00	7,510 00
				14.870		$12,090 00	$2,780 00
				.706		706 00	
				15.576		12,796 00	2,780 00
	22.957						$11,479 00
	14.412						7,206 00
	37.369						18,685 00

TABLE NO. 8.—*Showing Summary by counties for fiscal*

Note three lines of figures for each county.

Name of county.	Accepted applications in miles by classes.					
	A.	B.	C.	D.	E.	F.
Alger					8.551	
					8.551	
Allegan		.996	2.799		2.000	
	.800				2.608	
	.800	.996	2.799		4.608	
Antrim		44.005		5.667	2.355	
		6.750				
		50.755		5.667	2.355	
Arenac		1.010				
		1.010				
Baraga		1.000				
		—1.000				
Barry		24.773				
		8.861				
		33.634				
Bay	.997		.998		48.805	.161
		2.996	1.000		7.106	
	.997	2.996	1.998		55.911	.161
Benzie		29.420				
		35.096				
		64.516				
Berrien		7.881	1.746		39.065	
	.250	1.571		5.865	2.321	2.000
	.250	9.452	1.746	5.865	41.386	2.000
Branch		24.459				
		22.066				
		46.525				
Calhoun		50.121			7.566	
		43.890			4.096	
		94.011			11.662	
Cass		14.010				
		5.962				
		19.972				
Charlevoix		5.919				
		1,850			5.420	
		7.769			5.420	
Cheboygan		6.856	2.640	1.515	10.780	
		1,458	—.010		3.062	
		8.314	2.630	1.515	13.842	
Clare	1.494	13.973				
		3.000				
	1.494	16.973				
Clinton						
		3.010				
		3.010				
Crawford		6.960	5.595			
		3.088	1.059		1.238	
		10.048	6.654		1.238	
Delta					60.862	
					5.291	
					66.153	
Dickinson					14.969	
					.607	
					15.576	
Eaton		33.799				
		33.166				
		66.965				

year, July 1, 1912, up to close of day June 30, 1913.

Line 1.—Totals to July 1, 1912.
Line 2.—Business of fiscal year.
Line 3.—Totals close of day, June 30, 1913.

Miles of road built by classes.						Reward paid to—	
A.	B.	C.	D.	E.	F.	Counties.	Townships.
				8.551		$8.551 00	
				8.551		8.551 00	
	.500	1.503		1.000			$2.377 00
.800		1.000		1.814			2.765 00
.800	.500	2.503		2.814			5.142 00
	29.182		4.663				$18,087 00
	6.239						3,119 00
	35.421		4.663				21,206 00
	1.010						$505 00
	1.010						505 00
	15.742						$7,871 00
	7.144						3,572 00
	22.886						11,443 00
				38.160		$38.160 00	
				10.628	.161	10,789 00	
				48.788	.161	48,949 00	
	18.969						$9,484 00
	8.311						4,156 00
	27.280						13,640 00
	3,516	1.000		12.936			$15,444 00
.250	.125		2.375	10.427	.889	$6,924 00	6,298 00
.250	3.641	1.000	2.375	23.363	.889	6,924 00	21,742 00
	10.832						$5,416 00
	4.056						2,028 00
	14.888						7,444 00
	28.013			5.037			$19,044 00
	15.770			1.413			9,298 00
	43.783			6.450			28,342 00
	10.506						$5,253 00
	6.962						3,481 00
	17.468						8,734 00
	1.475						$738 00
	2.016						1,008 00
	3.491						1,746 00
	2.576	2.630	1.515	4.119		$8,516 00	
				3.833		3,833 00	
	2.576	2.630	1.515	7.952		12.349 00	
1.000	7.051						$3,775 00
	2.680						1,340 00
1.000	9.731						5,115 00
	4.852	2.223					$4,093 00
	2.072	2.071					2,589 00
	6.924	4.294					6,682 00
				34.243		$27,124 00	$7,119 00
				5.204		4,813 00	391 00
				39.447		31,937 00	7,510 00
				14.870		$12,090 00	$2,780 00
				.706		706 00	
				15.576		12,796 00	2,780 00
	22.957						$11,479 00
	14.412						7,206 00
	37.369						18,685 00

TABLE NO. 8.—

Note three lines of figures for each county.

Name of county.	Accepted applications in miles by classes.					
	A.	B.	C.	D.	E.	F.
Leelanau		3.018				
		2.870				
		5.888				
Livingston		33.185				
		15.082				
		48.267				
Luce				1.240		
				—.241		
				.999		
Macomb		1.074			2.000	
		3.052	4.306		2.026	
		4.126	4.306		4.026	
Manistee	1.000	77.017			1.668	
		.318				
	1.000	77.335			1.668	
Marquette					12.654	
					12.654	
Mason	1.500	49.623		.998	20.154	
	—.500	24.864			1.502	
	1.000	74.487		.998	21.656	
Mecosta		46.552				
		14.060				
		60.612				
Menominee		13.256	16.639		11.519	
		6.070	—3.159		—2.085	
		19.326	13.480		9.434	
Midland	.500	4.460				
	1.626	1.962				
	2.126	6.422				
Missaukee		10.006	2.992			
		4.004	4.776		1.500	
		14.010	7.768		1.500	
Monroe					36.506	
					9.526	
					46.032	
Montcalm	1.345	45.123				
		17.434				
	1.345	62.557				
Muskegon	1.016	18.728			36.085	
	1.760	1.010	1.008		2.482	
	2.776	19.738	1.008		38.567	
Newaygo	1.000	20.363			9.749	
	—1.000	9.350				
		29.713			9.749	
Oakland		27.945	1.429	2.236	2.004	
		7.068				
		35.013	1.429	2.236	2.004	
Oceana		14.169			43.096	
		—.506			11.031	
		13.663			54.127	
Ogemaw		5,056				
		1.002				
		6.058				
Ontonagon						
					7.000	
					7.000	
Osceola		35.677	1.750		5.474	
		—3.993				
		31.684	1.750		5.474	

CONTINUED.

Line 1.—Totals to July 1, 1912.
Line 2.—Business of fiscal year.
Line 3.—Totals close of day, June 30, 1913.

Miles of road built by classes.						Reward paid to—	
A.	B.	C.	D.	E.	F.	Counties.	Townships.
....	....	....	....	....	....	....	....
....	1.430	....	....	....	....	....	$715 00
....	1.430	....	....	....	....	....	715 00
....	9,716	....	....	....	....	....	$4,858 00
....	17.765	....	....	....	....	....	8,883 00
....	27.481	....	....	....	....	....	13,741 00
....	....	....	.999	....	....	$750 00	....
....	....	....	....	....	....	....	....
....	....	....	.999	....	....	750 00	....
....	....	....	....	2.000	....	....	$2,000 00
....	....	....	....	....	....	....	....
....	....	....	....	2.000	....	....	2,000 00
....	41.088	....	....	.660	....	$17,396 00	$3,809 00
1.000	6.763	....	....	....	....	1,875 00	1,756 00
1.000	47.851	....	....	.660	....	19,271 00	5,565 00
....	....	....	....	12.040	....	$12,040 00	....
....	....	....	....	....	....	....	....
....	....	....	....	12.040	....	12,040 00	....
1.000	9.229	....	.500	10.497	....	$12,480 00	$3,256 00
....	10.398	....	....	3.475	....	8,674 00	....
1.000	19.627	....	.500	13.972	....	21,154 00	3,256 00
....	27.132	....	....	....	....	$6,730 00	$6,836 00
....	12.448	....	....	....	....	2,706 00	3,518 00
....	39.580	....	....	....	....	9,436 00	10,354 00
....	12.756	7.200	....	6.030	....	$15,019 00	$2,789 00
....	3.298	1.600	....	1.363	....	2,563 00	1,649 00
....	16.054	8.800	....	7.393	....	17,582 00	4,438 00
....	3.460	....	....	....	....	....	$1,730 00
1.000	2.000	....	....	....	....	....	1,250 00
1.000	5.460	....	....	....	....	....	2,980 00
....	3.012	.992	....	....	....	....	$2,250 00
....	2.124	3.000	....	....	....	....	3.312 00
....	5.136	3.992	....	....	....	....	5,562 00
....	....	....	....	14.396	....	....	$14,396 00
....	....	....	....	7.930	....	....	7,930 00
....	....	....	....	22.326	....	....	22,326 00
1.345	24.049	....	....	....	....	....	$12,360 00
....	21.060	....	....	....	....	....	10,530 00
1,345	45.109	....	....	....	....	....	22,890 00
1.016	7.304	....	....	30.934	....	$30,575 00	$4,265 00
....	5.038	....	....	6.816	....	8,666 00	669 00
1.016	12.342	....	....	37.750	....	39,241 00	4,934 00
....	14.860	....	....	7.905	....	....	$15,336 00
....	7,256	....	....	.840	....	....	4,468 00
....	22.119	....	....	8.745	....	....	19,804 00
....	18.595	....	....	2.004	....	....	$11,302 00
....	2.054	....	1.000	....	....	....	1,777 00
....	20.649	....	1.000	2.004	....	....	13,079 00
....	7.699	....	....	31.832	....	....	$35,682 00
....	2.741	....	....	11.342	....	....	12,712 00
....	10.440	....	....	43.174	....	....	48,394 00
....	2.000	....	....	....	....	$1,000 00	....
....	3.056	....	....	....	....	1,528 00	....
....	5.056	....	....	....	....	2,528 00	....
....	....	....	....	....	....	....	....
....	....	....	....	1.000	....	$1,000 00	....
....	....	....	....	1.000	....	1,000 00	....
....	18.975	....	....	4.971	....	....	$14,459 00
....	4.550	1.000	....	....	....	....	3,025 00
....	23.525	1.000	....	4.971	....	....	17,484 00

TABLE NO. 8.—

Note three lines of figures for each county.

Name of county.	Accepted applications in miles by classes.					
	A.	B.	C.	D.	E.	F.
Ottawa		6.086				
		39.650				
		45.736				
Presque Isle		1.002				
		.018				
		1.020				
Roscommon		5.518				
		5.518				
Saginaw		4.832	1.522		104.779	
	2.032	.526			15.533	
	2.032	5.358	1.522		120.312	
St. Clair		3.740			27.565	
		2.030			1.026	
		5.770			28.591	
St. Joseph	1.000	2.004				
		7.716				
	1.000	9.720				
Sanilac		13.513	2.000		3.996	
		9.026			3.002	
		22.539	2.000		6.998	
Schoolcraft		2.250			9.226	
					5.807	
		2.250			15.033	
Shiawassee	2.990	14.536				
		21.760				
	2.990	36.296				
Tuscola		62.904			4.250	
		11.260			—1.500	
		74.164			2.750	
Van Buren	2.345	24.471			2.581	
	.700	—7.002			2.924	
	3.045	20.469			5.505	
Washtenaw		1.034				
		2.886				
		3.920				
Wayne		15.957			9.540	36.138
		—2.331	7.957		.880	58.244
		13.626	7.957		10.420	94.382
Wexford		43.773	2.644	1.960	2.015	
		18.338	6.020			
		62.111	8.664	1.960	2.015	
Total	37.266	1,312.980	52.921	18.315	633.528	36.799
	12.176	655.210	36.097	7.708	117.824	60.244
	49.442	1,968.190	89.018	26.023	751.352	97.043

Grand total	Up to 1913 fiscal year, miles applied for	2,091.809
	During 1913 fiscal year, miles applied for	889.259
	End of 1913 fiscal year, miles applied for	2,981.068

CONCLUDED.

Line 1.—Totals to July 1, 1912.
Line 2.—Business of fiscal year.
Line 3.—Totals close of day, June 30, 1913.

Miles of road built by classes.						Reward paid to—	
A.	B.	C.	D.	E.	F.	Counties.	Townships.
	3.832						$1,916 00
	1.250						625 00
	5.082						2,541 00
	4.490						$2,245 00
	4.490						2.245 00
	2.171	1.522		81.319		$79,311 00	$4,235 00
2.032				15.907		16,415 00	
2.032	2.171	1.522		97.226		95,726 00	4,235 00
	2.224			17.726			$18,838 00
	1.516						758 00
	3.740			17.726			19,596 00
1.000							$250 00
	2.000						1,000 00
1.000	2.000						1,250 00
	6.909			3.996			$7,450 00
	1.000						500 00
	7.909			3.996			7,950 00
				3.041		$3,041 00	
				3.041		3,041 00	
2.494	9.504						$5,376 00
	9.252						4,626 00
2.494	18.756						10,002 00
	36.667			2.750		*$2,284 00	$18,800 00
	14.209						7,103 00
	50.876			2.750		*2,284 00	25,903 00
1.468	8.072			1.000			$5,403 00
1.077	3.270			.500			2,403 00
2.545	11.342			1.500			7,806 00
	1.034						$517 00
	1.034						517.00
	8.602			9.038	24.833	$36,891 00	$1,281 00
	2.444	.492		1.382	20.955	22,706 00	1,222 00
	11.046	.492		10.420	45.788	59,597 00	2,503 00
	23.468	2.644	1.000	2.015		$5,191 00	$11,290 00
	15.296	.992					8,392 00
	38.764	3.636	1.000	2.015		5,191 00	19,682 00
18.284	748.141	22.730	11.132	406.133	24.833	$380,755 00	$454,245 00
20.697	343.964	16.173	7.703	111.978	22.505	138,092 00	191,300 00
38.981	1,092.105	38.903	18.835	518.111	47.338	518,847 00	645,545 00

Miles built	1,231.253	Reward paid	$835,000 00
Miles built	523.020	Reward paid	329,392 00
Miles built	1,754.273	Reward paid	1,164,392 00

*Payment to Good Roads Districts.

TABLE No. 9.—*Summary by counties for*

Note three lines of figures for each county

Name of county.	Accepted applications in miles by classes.					
	A.	B.	C.	D.	E.	F.
Alger	....	....	....	....	8.551	....
	....	....	....	....	5.012	....
	....	....	....	....	13.563	....
Allegan	.800	.996	2.799	....	4.608	....
	....	11.022	1.704	....	1.000	....
	.800	12.018	4.503	....	5.608	....
Alpena	....	....	....	....	....	....
	....	....	....	....	3.042	....
	....	....	....	....	3.042	....
Antrim	....	50.755	....	5.667	2.355	....
	....	19.869	1.004	−1.004	−2.355	....
	....	70.624	1.004	4.663	....	....
Arenac	....	1.010	....	....	....	....
	....	1.013	....	....	....	....
	....	2.023	....	....	....	....
Barry	....	33.634	....	....	....	....
	....	10.256	....	....	....	....
	....	43.890	....	....	....	....
Bay	.997	2.996	1.998	....	55.911	.161
	2.200	1.998	−.998	....	4.311	....
	3.197	4.994	1.000	....	60.222	.161
Benzie	....	64.516	....	....	....	....
	....	23.459	....	....	....	....
	....	87.975	....	....	....	....
Berrien	.250	9.452	1.746	5.865	41.386	2.000
	....	−1.425	−.746	−3.490	26.495	−.831
	.250	8.027	1.000	2.375	67.881	1.169
Branch	....	46.525	....	....	....	....
	....	−1.765	....	....	....	....
	....	44.760	....	....	....	....
Calhoun	....	96.011	....	....	11.662	....
	....	21.760	2.000	....	1.000	....
	....	117.771	2.000	....	12.662	....
Cass	....	19.972	....	....	....	....
	....	14.818	....	....	....	....
	....	34.790	....	....	....	....
Charlevoix	....	7.769	....	....	5.420	....
	....	−.572	....	....	8.870	....
	....	7.197	....	....	14.290	....
Cheboygan	....	8.314	2.630	1.515	13.842	....
	....	3.205	....	....	8.218	....
	....	11.519	2.630	1.515	22.060	....
Clare	1.494	16.973	....	....	....	....
	....	13.423	....	....	....	....
	1.494	30.396	....	....	....	....
Clinton	....	3.010	....	....	....	....
	....	2.812	2.014	....	....	....
	....	5.822	2.014	....	....	....

fiscal year ending June 30, 1914.

Line 1.—Totals to July 1, 1913.
Line 2.—Business of the fiscal year.
Line 3.—Totals including June 30, 1914.

Miles of road built by classes.						Reward paid in dollars to counties and townships.			
						State reward fund.		Trunk line fund.	
A.	B.	C.	D.	E.	F.	Counties.	Townships.	Counties.	Townships.
....	....	....	....	8.551	....	$8,551	....	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	....	8.551	....	8,551	....	....	....
.800	.500	2.503	....	2.814	....	....	$5,142	....	....
....	.804	....	....	1.794	....	275	1,946	....	....
.800	1.304	2.503	....	4.608	....	275	7,088	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....
....	35.421	....	4.663	....	....	....	21,206	....	....
....	7.312	1.004	....	....	....	....	4,409	....	....
....	42.733	1.004	4.663	....	....	....	25,615	....	....
....	1.010	....	....	....	....	....	505	....	....
....	1.013	....	....	....	....	....	658	....	....
....	2.023	....	....	....	....	....	1,163	....	....
....	22.886	....	....	....	....	....	11,443	....	....
....	13.504	....	....	....	....	....	7,455	....	$1,706
....	36.390	....	....	....	....	....	18,898	....	1,706
....	....	....	....	48,788	.161	48,949	....	....	....
....	.996	1.000	....	8.631	....	9,381	498	....	....
....	.996	1.000	....	57.419	.161	58,330	498	....	....
....	27.280	....	....	....	....	....	13,640	....	....
....	17.909	....	....	....	....	1,154	9,037	$1,154	1,605
....	45.189	....	....	....	....	1,154	22,677	1,154	1,605
.250	3.641	1.000	2.375	23.363	.889	6,924	21,742	....	....
....	.500	....	....	10.825	....	8,268	5,112	....	....
.250	4.141	1.000	2.375	34.188	.889	15,192	26,854	....	....
....	14.888	....	....	....	....	....	7,444	....	....
....	1.881	....	....	....	....	1,599	....	....	....
....	16.769	....	....	....	....	1,599	7,444	....	....
....	43.783	....	....	6.450	....	....	28,342	....	....
....	23.018	.340	....	2.509	....	9,588	6,457	2,997	....
....	66.801	.340	....	8.959	....	9,588	34,799	2,997	....
....	17.468	....	....	....	....	....	8,734	....	....
....	5.004	....	....	....	....	....	2,502	....	....
....	22.472	....	....	....	....	....	11,236	....	....
....	3.491	....	....	....	....	....	1,746	....	....
....	....	....	....	6.273	....	6,273	....	....	....
....	3.491	....	....	6.273	....	6,273	1,746	....	....
....	2.576	2.630	1.515	7.952	....	12,349	....	....	....
....	....	....	....	.270	....	270	....	....	....
....	2.576	2.630	1.515	8.222	....	12,619	....	....	....
1.000	9.731	....	....	....	....	....	5,115	....	....
....	4.244	....	....	....	....	....	2,122	....	....
1.000	13.975	....	....	....	....	....	7,237	....	....
....	....	....	....	....	....	....	....	....	....
....	3.010	....	....	....	....	....	1,505	....	....
....	3.010	....	....	....	....	....	1,505	....	....

TABLE NO. 9—

Note three lines of figures for each county

Name of county.	Accepted applications in miles by classes.					
	A.	B.	C.	D.	E.	F.
Crawford	....	10.048	6.654	....	1.238	....
	3.000	.904	−2.360	....	−.238	....
	3.000	10.952	4.294	....	1.000	....
Delta	....	....	....	....	66.153	....
	....	....	....	....	24.138	....
	....	....	....	....	90.291	....
Dickinson	....	....	....	....	15.576	....
	5.000	....	....	....	....	....
	5.000	....	....	....	15.576	....
Eaton	....	66.965	....	....	....	....
	....	30.228	....	....	....	....
	....	97.193	....	....	....	....
Emmet	....	13.314	....	.142	9.129	....
	....	1.433	....	....	5.754	....
	....	14.747	....	.142	14.883	....
Genesee	.678	135.592	12.745	4.328	22.173	....
	....	50.257	2.212	9.083	−10.272	....
	.678	185.849	14.957	13.411	11.901	....
Gladwin	....	....	....	....	....	....
	26.000	1.004	....	....	....	....
	26.000	1.004	....	....	....	....
Gogebic	....	15.794	....	....	3.060	....
	....	−9.068	....	....	....	....
	....	6.726	....	....	3.060	....
Grand Traverse	.920	36.962	....	.313	....	....
	....	11.595	....	4.298	1.000	....
	.920	48.557	....	4.611	1.000	....
Gratiot	13.397	121.068	....	....	....	....
	12.564	6.640	....	....	....	....
	25.961	127.708	....	....	....	....
Hillsdale	....	22.620	....	....	1.000	....
	....	6.908	....	....	4.239	....
	....	29.528	....	....	5.239	....
Houghton	....	....	....	....	9.898	....
	....	....	....	....	5.615	....
	....	....	....	....	15.513	....
Huron	3.990	31.148	5.436	....	33.306	.500
	−.300	38.196	−.500	....	1.873	5.972
	3.690	69.344	4.936	....	35.179	6.472
Ingham	....	23.004	....	....	2.000	....
	.500	14.594	2.532	....	1.516	....
	.500	37.598	2.532	....	3.516	....
Ionia	....	28.110	....	....	....	....
	....	13.310	....	....	....	....
	....	41.420	....	....	....	....
Iosco	2.356	1.394	....	....	5.364	....
	2.438	7.881	....	....	1.000	....
	4.794	9.275	....	....	6.364	....

Continued.

Line 1.—Totals to July 1, 1913.
Line 2.—Business of the fiscal year.
Line 3.—Totals including June 30, 1914.

Miles of road built by classes.						Reward paid in dollars to counties and townships.			
						State reward fund.		Trunk line fund.	
A.	B.	C.	D.	E.	F.	Counties.	Townships.	Counties.	Townships.
....	6.924	4.294	....	....	....	....	$6,682	....	....
2.008	2.110	....	....	1.000	....	....	2,557	....	....
2.008	9.034	4.294	....	1.000	....	....	9,239	....	....
....	....	....	....	39.447	....	$31,937	7,510	....	....
....	....	....	....	4,017	....	1,134	3,350	....	....
....	....	....	....	43.464	....	33,071	10,860	....	....
....	....	....	....	15.576	....	12,796	2,780	....	....
....	....	....	....	....	....	....	....	$5,421	....
....	....	....	....	15.576	....	12,796	2.780	5,421	....
....	37.369	....	....	....	....	....	18,685	....	....
....	23.802	....	....	....	....	5,217	6,684	....	....
....	61.171	....	....	....	....	5,217	25,369	....	....
....	8.736	....	.142	5.300	....	9,623	....	....	....
....	1.960	....	....	5.275	....	6,406	....	1,421	....
....	10.696	....	.142	10.575	....	16,029	....	1,421	....
.678	27.465	5.026	4.328	10.795	....	18,227	13,486	....	....
....	51.642	8.981	1.000	.606	....	33,662	670	3,527	....
.678	79.107	14.007	5.328	11.401	....	51,889	14,156	3,527	....
....	....	....	....	....	....	....	....	....	....
....	.500	....	....	....	....	250	....	....	....
....	.500	....	....	....	....	250	....	....	....
....	....	....	....	3.060	....	3,060	....	....	....
....	3.578	....	....	....	....	1,789	....	1,530	....
....	3.578	....	....	3.060	....	4,849	....	1,530	....
.920	24.164	....	.313	....	....	6,909	5,637	....	....
....	13.871	....	....	....	....	2,063	6,076	2,841	....
.920	38.035	....	.313	....	....	8,972	11,713	2,841	....
9.719	91.434	....	....	....	....	....	48,146	....	....
6.978	12.014	....	....	....	....	....	8,108	....	$1,368
16.697	103.448	....	....	....	....	....	56,254	....	1,368
....	18.626	....	....	1.000	....	....	10,312	....	....
....	6.872	....	....	3.489	....	....	7,130	....	....
....	25.498	....	....	4.489	....	....	17,442	....	....
....	....	....	....	6.669	....	6,669	....	....	....
....	....	....	....	5.255	....	8,408	....	11,742	....
....	....	....	....	11.924	....	15,077	....	11,742	....
3.690	22.154	4.008	....	15.361	.500	....	30,866	....	....
....	18.586	.428	....	10.804	....	....	20,718	....	800
3.690	40.740	4.436	....	26.165	.500	....	51,584	....	800
....	12.364	....	....	2.000	....	....	8,182	....	....
....	8.110	....	....	....	....	....	4,055	....	....
....	20.474	....	....	2.000	....	....	12,237	....	....
....	16.300	....	....	....	....	....	8,150	....	....
....	11.084	....	....	....	....	....	5,542	....	....
....	27.384	....	....	....	....	....	13,692	....	....
1.344	....	....	....	5.364	....	5,700	....	....	....
3.166	....	....	....	....	....	126	666	....	....
4.510	....	....	....	5.364	....	5,826	666	....	....

TABLE No. 9—

Note three lines of figures for each county

Name of county.	Accepted applications in miles by classes.					
	A.	B.	C.	D.	E.	F.
Iron	....	14.018	5.126	....	4.510	....
	....	.650	1.315	....	3.552	....
	....	14.668	6.441	....	8.062	....
Isabella	....	56.072	....	....	....	....
	....	10.440	....	....	....	....
	....	66.512	....	....	....	....
Jackson	1.098	25.228	....	....	4.888	....
	—.098	18.478	6.616	....	—.388	....
	1.000	43.706	6.616	....	4.500	....
Kalamazoo	2.740	78.657	....	1.000	12.034	....
	....	2.087	1.512	....	4.390	1.176
	2.740	80.744	1.512	1.000	16.424	1.176
Kalkaska	3.408	28.519	....	1.000	6.274	....
	....	5.030	....	.994	.512	....
	3.408	33.549	....	1.994	6.786	....
Kent	....	50.007	....	....	3.497	....
	....	43.302	11.010	....	3.015	....
	....	93.309	11.010	....	6.512	....
Keweenaw	....	....	....	....	2.002	....
	....	....	....	....	....	....
	....	....	....	....	2.002	....
Lake	....	13.582	....	....	....	....
	....	4.095	....	....	....	....
	....	17.677	....	....	....	....
Lapeer	....	18.759	....	....	....	....
	1.004	10.020	4.512	....	....	....
	1.004	28.779	4.512	....	....	....
Leelanau	....	5.888	....	....	....	....
	....	16.768	....	....	....	....
	....	22.656	....	....	....	....
Lenawee	....	....	....	....	....	....
	....	....	....	....	2.160	....
	....	....	....	....	2.160	....
Livingston	....	48.267	....	....	....	....
	....	8.057	....	....	....	....
	....	56.324	....	....	....	....
Luce	....		....	.999	....	....
	....	....	....	....	....	....
	....	....	....	.999	....	....
Macomb	....	4.126	4.306	....	4.026	....
	....	1.508	15.720	....	1.038	....
	....	5.634	20.026	....	5.064	....
Manistee	1.000	77.335	....	....	1.668	....
	.120	5.093	....	....	4.454	....
	1.120	82.428	....	....	6.122	....
Marquette	....	....	....	....	12.654	....
	....	....	5.020	....	—.027	....
	....	....	5.020	....	12.627	....

Continued.

Line 1.—Totals to July 1, 1913.
Line 2.—Business of the fiscal year.
Line 3.—Totals including June 30, 1914.

Miles of road built by classes.						Reward paid in dollars to counties and townships.			
						State reward fund.		Trunk line fund.	
A.	B.	C.	D.	E.	F.	Counties.	Townships.	Counties.	Townships.
....	5.416	....	....	....	....	$2,708	....	....	....
....	....	1.418	....	4.510	....	9,476	....	$10,073	....
....	5.416	1.418	....	4.510	....	12,184	....	10,073	....
....	37.338	....	....	....	....	....	$18,668	....	....
....	14.648	....	....	....	....	....	7,324	....	....
....	51.986	....	....	....	....	....	25,992	....	....
1.000	11.034	....	....	4.500	....	....	10,267	....	....
....	11.750	2.268	....	....	....	6,866	2,051	2,892	....
1.000	22.784	2.268	....	4.500	....	6,866	12,318	2,892	....
2.740	52.894	....	1.000	6.607	....	34,098	390	....	....
....	17.570	.500	....	4.694	.435	16,752	....	6,313	....
2.740	70.464	.500	1.000	11.301	.435	50,850	390	6,313	....
3.408	21.753	....	1.000	4.806	....	11,880	5,404	....	....
....	3.062	....	.994	1.764	....	1,760	2,281	....	....
3.408	24.815	....	1.994	6.570	....	13,640	7,685	....	....
....	38.879	....	....	2.997	....	*9,626	12,811	....	....
....	2.842	....	....	....	....	....	1,421	....	....
....	41.721	....	....	2.997	....	*9,626	14,232	....	....
....	....	....	....	2.002	....	....	2,002	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	....	2.002	....	....	2,002	....	....
....	8.966	....	....	....	....	....	4,483	....	....
....	1.404	....	....	....	....	....	702	....	....
....	10.370	....	....	....	....	....	5,185	....	....
....	8.545	....	....	....	....	....	4,273	....	....
....	8.448	1.502	....	....	....	4,224	1,239	....	....
....	16.993	1.502	....	....	....	4,224	5,512	....	....
....	1.430	....	....	....	....	....	715	....	....
....	5.236	....	....	....	....	....	2,618	....	....
....	6.666	....	....	....	....	....	3,333	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	....	....	....	....	....	....	....
....	27.481	....	....	....	....	....	13,741	....	....
....	11.540	....	....	....	....	....	5,770	....	$817
....	39.021	....	....	....	....	....	19,511	....	817
....	....	....	.999	....	....	750	....	....	....
....	....	....	....	....	....	....	....	....	....
....	....	....	.999	....	....	750	....	....	....
....	....	....	....	2.000	....	....	2,000	....	....
....	3.074	5.777	....	....	....	8,019	537	5,015	....
....	3.074	5.777	....	2.000	....	8,019	2,537	5,015	....
1.000	47.851	....	....	.660	....	19,271	5,565	....	....
....	4.344	....	....	1.927	....	3,349	750	1,360	....
1.000	52.195	....	....	2.587	....	22,620	6,315	1,360	....
....	....	....	....	12.040	....	12,040	....	....	....
....	....	....	....	....	....	....	....	5,784	....
....	....	....	....	12.040	....	12,040	....	5,784	....

TABLE No. 9—

Note three lines of figures for each county

Name of county.	Accepted applications in miles by classes.					
	A.	B.	C.	D.	E.	F.
Mason	1.000 .992 1.992	74.487 10.656 85.143	....	.998 —.498 .500	21.656 —.500 21.156	....
Mecosta	....	60.612 15.178 75.790	....	....	....	....
Menominee	....	19.326 9.406 28.732	13.480 13.211 26.691	.... 4.734 4.734	9.434 1.223 10.657	....
Midland	2.126 .... 2.126	6.422 9.234 15.656	.... 2.482 2.482	....	.... 19.399 19.399	....
Missaukee	....	14.010 7.800 21.810	7.768 .497 8.265	....	1.500 .... 1.500	....
Monroe	....	....	.... 2.102 2.102	....	46.032 —.532 45.500	....
Montcalm	1.345 2.752 4.097	62.557 20.868 83.425	....	....	....	....
Muskegon	2.776 .... 2.776	19.738 1.817 21.555	1.008 5.711 6.719	....	38.567 1.750 40.317	....
Newaygo	....	29.713 22.098 51.811	.... .307 .307	....	9.749 —1.004 8.745	....
Oakland	....	35.013 34.346 69.359	1.429 15.861 17.290	2.236 —.229 2.007	2.004 1.486 3.490	.... 1.317 1.317
Oceana	....	13.663 10.598 24.261	....	....	54.127 7.480 61.607	....
Ogemaw	....	6.058 3.010 9.068	.... 2.982 2.982	....	....	....
Ontonagon	....	....	....	....	7.000 1.566 8.566	....
Osceola	....	31.684 24.305 55.989	1.750 .... 1.750	.... .556 .556	5.474 .... 5.474	....
Ottawa	....	45.736 .543 46.279	....	....	.... 2.280 2.280	....
Presque Isle	....	1.020 2.870 3.890	....	....	....	....

Continued.

Line 1.—Totals to July 1, 1913.
Line 2.—Business of the fiscal year.
Line 3.—Totals including June 30, 1914.

Miles of road built by classes.						Reward paid in dollars to counties and townships.			
						State reward fund.		Trunk line fund.	
A.	B.	C.	D.	E.	F.	Counties.	Townships.	Counties.	Townships.
1.000	19.627	....	.500	13.972	....	$21,154	$3,256	....	....
....	15.600	....	....	....	....	6.033	1,767	....	....
1.000	35.227	....	.500	13.972	....	27,187	5,023	....	....
....	39.580	....	....	....	....	9,436	10,354	....	....
....	21.100	....	....	....	....	3,052	7,498	....	....
....	60.680	....	....	....	....	12,488	17,852	....	....
....	16.054	8.800	....	7.393	....	17,582	4,438	....	....
....	3.434	....	....	....	....	....	1,717	....	....
....	19.488	8.800	....	7.393	....	17,582	6,155	....	....
1.000	5.460	....	....	....	....	....	2,980	....	....
....	....	....	....	....	....	....	....	....	....
1.000	5.460	....	....	....	....	....	2,980	....	....
....	5.136	3.992	....	....	....	....	5,562	....	....
....	6.168	4.273	....	1.045	....	3,521	3,813	....	....
....	11.304	8.265	....	1.045	....	3,521	9.375	....	....
....	....	....	....	22.326	....	....	22,326	....	....
....	....	....	....	6.061	....	....	7,563	....	....
....	....	....	....	28.387	....	....	29,889	....	....
1.345	45.109	....	....	....	....	....	22,890	....	....
.744	15.518	....	....	....	....	....	8,023	....	....
2.089	60.627	....	....	....	....	....	30,913	....	....
1.016	12.342	....	....	37.750	....	39,241	4,934	....	....
1.000	6.175	.931	....	1.253	....	4,451	1,249	$7,781	....
2.016	18.517	.931	....	39.003	....	43,692	6,183	7,781	....
....	22.119	....	....	8.745	....	....	19,804	....	....
....	2.554	....	....	....	....	....	1,277	....	....
....	24.673	....	....	8.745	....	....	21,081	....	....
....	20.649	....	1.000	2.004	....	....	13,079	....	....
....	3.010	....	....	....	....	....	1,555	....	$641
....	23.659	....	1.000	2.004	....	....	14,634	....	641
....	10.440	....	....	43.174	....	....	48,394	....	....
....	.995	....	....	6.276	....	....	9,023	....	1,990
....	11.435	....	....	49.450	....	....	57,417	....	1,990
....	5.056	....	....	....	....	2,528	....	....	....
....	....	....	....	....	....	....	....	....	....
....	5.056	....	....	....	....	2,528	....	....	....
....	....	....	....	1.000	....	1,000	....	....	....
....	....	....	....	1.566	....	1,000	566	....	....
....	....	....	....	2.566	....	2,000	566	....	....
....	23.525	1.000	....	4.971	....	....	17,484	....	....
....	3.812	....	....	....	....	....	1,906	....	375
....	27.337	1.000	....	4.971	....	....	19,390	....	375
....	5.082	....	....	....	....	....	2,541	....	....
....	4.046	....	....	1.000	....	3,775	....	....	....
....	9.128	....	....	1.000	....	3,775	2,541	....	....
....	....	....	....	....	....	....	....	....	....
....	1.020	....	....	....	....	....	510	....	....
....	1.020	....	....	....	....	....	510	....	....

TABLE No. 9—

Note three lines of figures for each county

Name of county.	Accepted applications in miles by classes.					
	A.	B.	C.	D.	E.	F.
Roscommon	....	5.518	....	....	....	....
	....	−1.028	....	....	....	....
	....	4.490	....	....	....	....
Saginaw	2.032	5.358	1.522	....	120.312	....
	....	4.813	....	....	36.558	....
	2.032	10.171	1.522	....	156.870	....
Sanilac	....	22.539	2.000	....	6.998	....
	....	20.080	−2.000	....	3.501	....
	....	42.619	....	....	10.499	....
Schoolcraft	....	2.250	....	....	15.006	....
	....	....	....	....	.004	....
	....	2.250	....	....	15.010	....
Shiawassee	2.990	36.296	....	....	....	....
	.890	33.954	....	....	....	....
	3.880	70.250	....	....	....	....
St. Clair	....	5.770	....	....	28.591	....
	.746	12.364	....	....	8.255	.506
	.746	18.134	....	....	36.846	.506
St. Joseph	1.000	9.720	....	....	....	....
	....	6.876	2.582	....	5.208	....
	1.000	16.596	2.582	....	5.208	....
Tuscola	....	74.164	....	....	2.750	....
	....	23.624	9.000	....	2.750	....
	....	97.788	9.000	....	5.500	....
Van Buren	3.045	20.469	....	....	5.505	....
	−.500	.814	4.698	....	13.570	....
	2.545	21.283	4.698	....	19.075	....
Washtenaw	....	3.920	....	....	....	....
	....	18.228	3.088	....	....	....
	....	22.148	3.088	....	....	....
Wayne	....	13.626	7.957	....	10.420	94.382
	....	−.881	6.163	....	−.436	5.180
	....	12.745	14.120	....	9.984	99.562
Wexford	....	62.111	8.664	1.960	2.015	....
	....	5.765	4.109	1.054	....	....
	....	67.876	12.773	3.014	2.015	....
Total	49.442	1,970.190	89.018	26.023	751.325	97.043
	57.308	716.621	122.360	15.498	211.482	13.320
	106.750	2,686.811	211.378	41.521	962.807	110.363
Grand total	....	....	....	....	....	2,983.041 1,136.589 4,119.630

*Includes payments made to Good Road Districts.

—Minus in application column indicates cancellation.

—Minus in built column indicates rebuilt under some other class.

Concluded.

Line 1.—Totals to July 1, 1913.
Line 2.—Business of the fiscal year.
Line 3.—Totals including June 30, 1914.

Miles of road built by classes.						Reward paid in dollars to counties and townships.			
						State reward fund.		Trunk line fund.	
A.	B.	C.	D.	E.	F.	Counties.	Townships.	Counties.	Townships.
....	4.490	....	....	....	....	....	$2,245	....	....
....	....	....	....	....	....	....	....	....	....
....	4.490	....	....	....	....	....	2,245	....	....
2.032	2.171	1.522	....	97.226	....	$95,726	4,235	....	....
....	4.150	....	....	22.034	....	24,109	....	$2,470	....
2.032	6.321	1.522	....	119.260	....	119,835	4,235	2,470	....
....	7.909	....	....	3.996	....	....	7,950	....	....
....	8.000	....	....	2.500	....	....	6,500	....	....
....	15.909	....	....	6.496	....	....	14,450	....	....
....	....	....	....	3.041	....	3,041	....	....	....
....	....	....	....	8.949	....	9,778	....	5,113	....
....	....	....	....	11.990	....	12,819	....	5,113	....
2.494	18.756	....	....	....	....	....	10,002	....	....
....	20.734	....	....	....	....	8.765	2,379	1,701	....
2.494	39.490	....	....	....	....	8,765	12,381	1,701	....
....	3.740	....	....	17.726	....	....	19,596	....	....
....	....	....	....	1.026	.506	....	1,532	....	....
....	3.740	....	....	18.752	.506	....	21,128	....	....
1.000	2.000	....	....	....	....	....	1,250	....	....
....	2.644	....	....	.500	....	1,697	125	....	....
1.000	4.644	....	....	.500	....	1,697	1,375	....	....
....	50.876	....	....	2.750	....	*2,284	25,903	....	....
....	19.894	1.000	....	−1.000	....	528	9,469	....	....
....	70.770	1.000	....	1.750	....	*2,812	35,372	....	....
2.545	11.342	....	....	1.500	....	....	7,806	....	....
−.500	6.265	....	....	4.851	....	....	8,856	....	$2,263
2.045	17.607	....	....	6.351	....	....	16,662	....	2,263
....	1.034	....	....	....	....	....	517	....	....
....	1.430	....	....	....	....	....	715	....	....
....	2,464	....	....	....	....	....	1,232	....	....
....	11.046	.492	....	10.420	45.788	59,597	2,503	....	....
....	1.072	7.542	....	—.436	18.613	31,356	2,084	26,196	....
....	12.118	8.034	....	9.984	64.401	90,953	4,587	26,196	....
....	38.764	3.636	1.000	2.015	....	5,191	19,682	....	....
....	13.262	2.000	2.014	....	....	4,223	5,419	....	747
....	52.026	5.636	3.014	2.015	....	9,414	25,101	....	747
38.981	1,092.105	38.903	18.835	518.111	47.338	*$518,847	$645,545	....	....
13.396	478.125	37.964	4.008	129.268	19.554	248.597	215,496	$105,331	$12,312
52.377	1,570.230	76.867	22.843	647.379	66.892	*767,444	861,041	105,331	12,312
....	....	....	....	....	1,754.273	....	$1,164,392	....	....
....	....	....	....	....	682.315	....	464,093	....	$117,643
....	....	....	....	....	2,436.588	....	1,628,485	....	117,643

STATE REWARD ROAD LAW.

Chapter V, Act 283, 1909, as amended by Act 148, 1911, and Act 355, 1913.

CHAPTER V.

STATE REWARD FOR ROADS.

State highway department, duties, etc.

SECTION 1. There is hereby created and established a state highway department, which shall be charged with the giving of instruction in the art of building, improving and repairing public wagon roads and bridges, collecting reports from township and county highways commissioners, overseers of highways and superintendents and commissioners of streets in villages and cities, and with the distribution of any State reward for improving the public wagon roads, that this legislature or any future session may provide for, or any funds that may be given to the State for such purposes by the United States government.

For general appropriation act for 1914-15, for State reward fund, and for act requiring certain motor vehicle fees to be applied to the State highway fund, see secs. 416-18.

State highway commissioner, appointment, etc.

SEC. 2. The chief officer of said department shall be denominated as the state highway commissioner. He shall be a citizen of this State, and shall have his office at the seat of government and shall personally superintend the duties thereof. He shall be appointed by the governor, by and with consent of the senate, on or before the first day of July, nineteen hundred nine, and shall hold his office on and after said first day of July, nineteen hundred nine, until the first day of July, nineteen hundred thirteen, and until his successor is duly elected and qualified as hereinafter provided. In the year nineteen hundred thirteen, and every four years thereafter, a state highway commissioner shall be nominated and elected by the people of the State of Michigan at the same time and in the same manner as the justices of the supreme court are nominated and elected. He shall take his oath of office July first following his election, and his term of office shall be four years from that date and until his successor is duly elected and qualified. He shall receive an annual salary of three thousand five hundred dollars.† The state highway commissioner may appoint two deputies,* one of whom shall be a competent civil engineer experienced in highway building. Such deputies shall take and subscribe the oath of office prescribed by the constitution, and whenever the commissioner shall be disabled from executing the duties of his

Election of, salary, etc.

Deputies.

Oath of office, duties, etc.

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†Owing to constitutional provisions preventing raise of salary after election, present commissioner receives only $2,500 per year.

*Only one deputy was appointed.

Building a grade over the sink-hole east of Williamston, on the trunk line in Ingham county. Work under direction of the County Road Commissioners. Grading contracted on a cubic yard basis.

Oakland County Road Commissioners have changed alignment of this road to its present location and have constructed a new culvert, thus securing a better grade at a slightly reduced distance. The road will be surfaced later with gravel.

office, he may designate one of said deputies, duly appointed, as aforesaid, who shall execute the duties of said commissioner until such disability be removed. Such deputies shall receive an annual salary of two thousand dollars each. **Salaries.** The commissioner may employ such other clerks and engineers as may be necessary to perform the duties incumbent upon the department. **How paid.** The salaries of the commissioner, deputy commissioner and others employed by authority of this act shall be paid upon the warrant of the auditor general in the same manner as other State officers and employes are paid; and all other expenses shall be approved by the board of state auditors and paid upon the warrant of the auditor general. **Vacancy.** Whenever a vacancy shall occur in said office of commissioner by reason of death, resignation or otherwise, the governor shall fill such vacancy by appointment, but such appointee shall hold office only until the next general State election when a new commissioner shall be elected for the unexpired term. **Oath and bond.** The commissioner so appointed shall, within fifteen days from the time of notice of his appointment, take and subscribe the oath of office prescribed by the constitution, and shall file the same in the office of the secretary of state, and the said commissioner shall give the people of the State of Michigan a bond in the penal sum of five thousand dollars, with sureties to be approved by the auditor general, conditioned for the faithful discharge of the duties of his office. **Biennial report.** The commissioner shall make a biennial report to the governor, which report shall contain the name and compensation of each and every person that may be or has been employed by the department, and the whole amount of the expenses of the department in the interim not previously reported. Such report shall be made on or before the first day of February, nineteen hundred nine, and every two years thereafter, and the commissioner shall have printed a sufficient number of these reports to provide every township highway commissioner and county road commissioner in the State with a copy, and such further number as may be necessary to satisfy the demand that the public weal may warrant.

Am. 1913, Act 355.

Annual road institute.

SEC. 3. The highway commissioners of the several townships in each and every county in the State, and the county highway commissioners in counties working under the county road law, shall if deemed advisable by the state highway commissioner, meet annually in a road institute, at such time and place in each county or adjoining county as the state highway commissioner may designate, there to consider such matters as he may present to their attention, and to discuss such matters of road improvement as may be of special interest to such township and county highway commissioners, and every township highway commissioner may collect from his township the same per diem for this day as for one spent in actual road work, and his actual expenses in attending such institute shall, if reasonable, be allowed by the township board and shall be paid by said township. Every county highway commissioner may collect from his county the same per diem for this day as for one spent in actual road work, and his actual expenses in attending such institute shall, if reasonable, be allowed by the board or committee, or county auditors who may have the authority in such matters in the county of which he is a county highway commissioner, and shall be paid by said county.

Per diem compensation.

Am. Id.

Reports of overseers, commissioners.

SEC. 4. At the request of the state highway commissioner, every road district overseer of highways, every township overseer of highways, every township highway commissioner, every county highway commissioner, and every village or city superintendent or commissioner of streets, shall make a sworn report to the state highway commissioner, on or before March first each year, answering such questions as the state highway commissioner shall deem proper to ask and they able to answer, giving him such information as he may require and their ability permit, appertaining to roads, bridges, streets, method of construction, materials, machinery and costs, upon blanks which he may furnish and send out.

Am. Id.

Penalty for refusal to make report.

SEC. 5. Any road district overseer of highways, or township overseer of highways, or township highway commissioner, or county highway commissioner, or village or city superintendent or commissioner of streets, who shall refuse or neglect to make such report at time stated or within thirty days thereafter, when requested to by the state highway commissioner, or who shall, in whole or in part, refuse or neglect to make such report at time stated or within thirty days thereafter, or who shall make a report which shall be in whole or in part false, shall be guilty of a misdemeanor, and upon conviction thereof, in any court of competent jurisdiction, be fined in any sum of not less than ten dollars and costs, and not exceeding one hundred dollars and costs, or be confined in jail not less than ten days, nor more than thirty days, for each and every offense, at the discretion of the court. Violations of the provisions of this act may be prosecuted in the name of the people of the State of Michigan, and it shall be the duty of the prosecuting attorney of each county to prosecute for any violation of the provisions contained in sections four and five of this chapter.

Violations, how prosecuted.

Plans and specifications for public wagon roads.

SEC. 6. It shall be the duty of the state highway commissioner to furnish outline plans and specifications for the improvement of public wagon roads, and, when requested to, and where proposed improvements are of sufficient importance to warrant, he shall go or send some one, to give expert advice of how to best build or improve public roads or bridges. He shall also gather all the information possible about all kinds of road building material in the State, its relative value, cost, and also cost of transportation to other places in the State, and to give this information upon request to any road or street official in the State free of charge to them.

Certain terms, how construed.

SEC. 7. The terms "roads" or "public roads" or "public wagon roads" in this act shall, at all times, be construed to mean the leading public wagon roads outside of incorporated villages and cities.

Am. 1913, Act 355. This section was also amended by act 246 of 1913. The second amendment leaves the text the same as in the original enactment.

Record of state department.

SEC. 8. The state highway commissioner shall keep a complete record of the doings of the state highway department, which record shall be the property of the State, and shall as soon as possible make a map of every township in the State showing the roads and the conditions of the roads, together with marks indicating where road building material can be found, and what kind and what quality.

Duty of commissioner upon application for allotment of state reward.

SEC. 9. Whenever any township shall file notice with the state highway department through its township board, or when any county commissioner in counties under the county road law, shall do likewise, that the township or townships acting conjointly on boundary line roads or county or counties acting conjointly on boundary line roads has made arrangements to improve a mile or more of public wagon road by building a clay gravel, a gravel, a stone gravel, a gravel stone or macadam road, and shall ask for an allotment of State reward, and shall file with the department a profile of the road to be improved, made out by a competent surveyor, and shall make application for outline plans and general specifications, it shall be the duty of the state highway commissioner to enter such application in the order in which it is received, and to furnish the outline plans and general specifications asked for, and, provided there are any funds in the State treasury not yet allotted, appropriated for State reward for roads, he shall make the allotment, and providing the fund appropriated for State reward, shall have all been allotted, then the allotment shall be made as soon as there shall be available funds in the State treasury. When any township or townships acting conjointly on boundary line roads or any county or counties acting conjointly on boundary line roads have built a mile or more of such road as is hereinafter described, and when inspected by the state highway commissioner, or by some one acting under authority of the commissioner is found to be up to the required standard, he shall, providing there are funds in the State treasury for the paying of this reward, verify the same to the auditor general of the State, who shall draw a warrant

Payment for roads built.

upon the state treasurer, payable to the proper authorities in such township or county or townships or counties for the amount of reward due them, for the amount and class of road built. And, providing there are no funds in the State treasury for the paying of such reward, as soon as sufficient moneys shall become available, the state highway commissioner shall verify the same to the auditor general, who shall draw his warrant as above set forth: Provided, That the road shall be kept in as good condition as when approved by the commissioner, until the payment of the reward thereon.

Proviso.

Roads meriting state reward.

SEC. 10. The following described roads, when built, shall merit the reward attached to each description:

$250 per mile.

(a) Every mile of well graded road on which the steepest incline shall not exceed six per centum, except where found impracticable and a steeper grade is recommended after examination by the state highway commissioner, and the width of which shall not be less than twenty feet between and exclusive of side ditches, and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide, made of a mixture of sand and clay or other material according to specifications furnished by the state highway commissioner, shall merit if approved by the state highway commissioner a reward from the State of two hundred fifty dollars, and pro rata for extra miles and fractions thereof in excess of the first mile, with an extra twenty-five dollars per mile for each additional foot in width of metaled surface in excess of nine feet up to and including sixteen feet;

$500 per mile.

(b) Every mile of well graded road on which the steepest incline shall not exceed six per centum, except where found impracticable and a steeper grade is recommended after examination by the state highway commissioner, and the width of which shall not be less than twenty feet between side ditches, and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide and which shall consist of not less than eight inches of compacted gravel, or not less than twelve inches of compacted burnt shale, which must be applied in not less than two layers, each layer to be rolled separately: Provided, That both shoulders and metaled track shall be properly crowned so as to shed water quickly to the side ditches, shall merit, if approved by the state highway commissioner, a reward from the State of five hundred dollars, and pro rata for extra miles and fractions thereof in excess of the first mile, with an extra fifty dollars per mile for each additional foot in width of metaled surface in excess of nine feet up to and including sixteen feet;

Proviso.

$750 per mile.

(c) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall not be less than twenty feet between side ditches and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide, made in two courses, the bottom course to be crushed stone, slag or other material, if approved by the state highway commissioner, and shall not be less than four inches thick after thorough rolling, and a top course consisting of a layer of gravel or blast furnace slag which shall not be less than three inches thick after being thoroughly rolled: Provided, That both shoulders and metaled track shall be properly crowned so as to shed water quickly to the side ditches, shall merit, if approved by the state highway commissioner, a reward from the State of seven hundred fifty dollars, and pro rata for extra miles and fractions thereof in excess of the first mile, with an extra seventy-five dollars per mile for each additional foot in width of metaled surface in excess of nine feet up to and including sixteen feet; Proviso.

(d) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall be not less than twenty feet between side ditches, and which shall be properly drained and have a wagon way or travel track not less than nine feet wide, made in two courses, the bottom course to be of gravel, slag or other materials, if approved by the state highway commissioner, and be not less than four inches thick after thorough rolling, and a top course consisting of a layer of crushed stone which shall be not less than three inches thick after being thoroughly rolled and properly bonded: Provided, That both shoulders and metaled track shall be properly crowned to shed water quickly to the side ditches, shall merit, if approved by the state highway commissioner, a reward from the State of seven hundred fifty dollars, and pro rata for extra miles and fractions thereof in excess of the first mile, with an extra seventy-five dollars per mile for each additional foot in width of metaled surface in excess of nine feet up to and including sixteen feet; $750 per mile. Proviso.

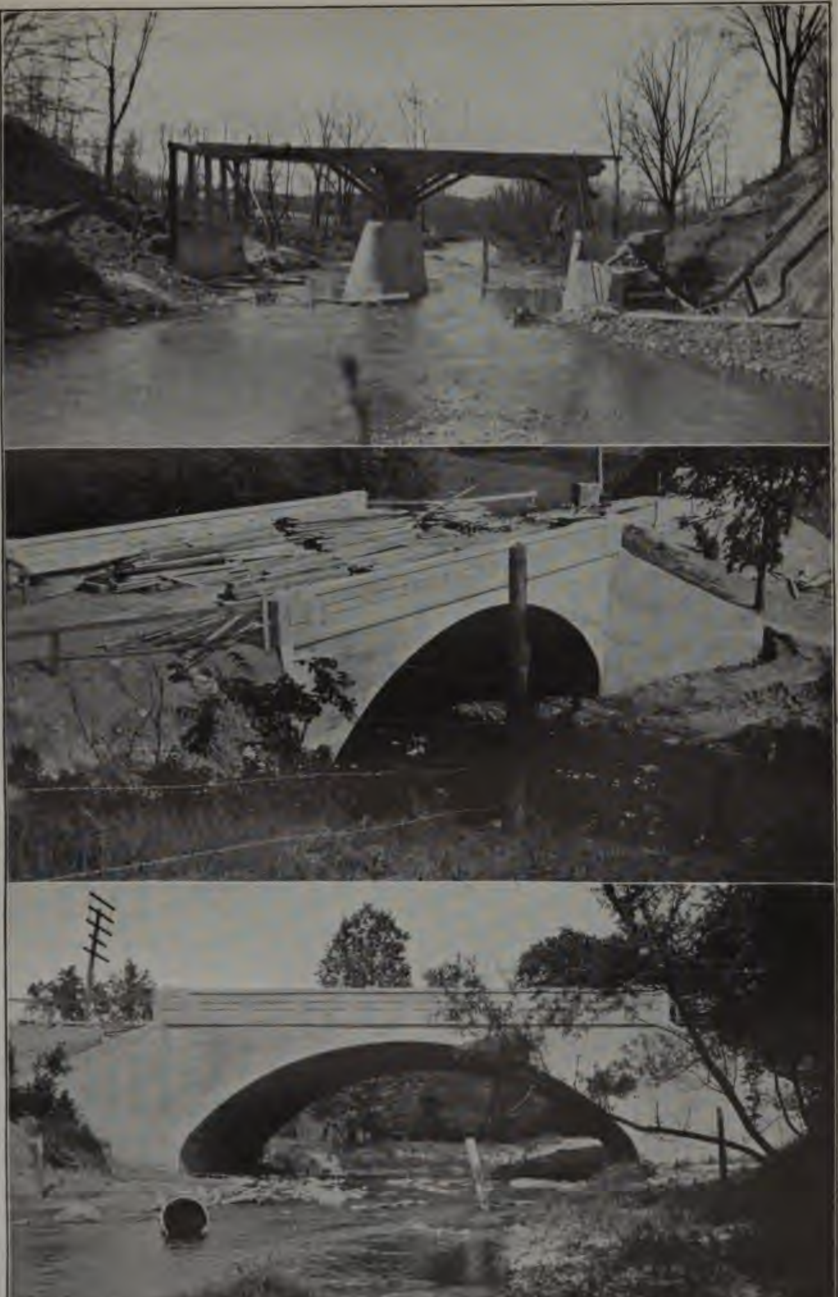
(e) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall not be less than twenty feet between side ditches, and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide of well compacted macadam not less than six inches thick laid in two courses of crushed stone, each to be properly bonded, with stone screenings, asphalt, bitumen, or other cement approved by the state highway commissioner, and thoroughly rolled: Provided, That both shoulders and metaled track shall be properly crowned so as to shed water quickly to the side ditches, shall merit, if approved by the state highway commissioner, a reward from the State of one thousand dollars, and pro rata for extra miles and fractions thereof in excess of the first mile, with an extra one hundred dollars per mile for each additional foot in width of macadamized surface in excess of nine feet up to and including sixteen feet; $1000 per mile. Proviso.

$1000 per mile. (f) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall not be less than twenty feet between side ditches, and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide in the clear between beveled edges and which shall consist of properly laid concrete not less than six inches in depth, composed of Portland cement and gravel, or sand and crushed stone, with or without a paving brick surface: Proviso. Provided, however, That the cement shall be required to meet the standard tests then in force of the American Society for Testing Materials, and that the other ingredients, the manner of laying and the kind of inspection employed shall be made to comply with specifications made by, or approved by the state highway commissioner, shall merit, if approved by the state highway commissioner, a reward from the State of one thousand dollars per mile and pro rata for extra miles and fractions thereof in excess of the first mile, with an extra one hundred dollars per mile for each additional foot in width of concrete surface up to and including sixteen feet;

$1000 per mile. (g) Every mile of well graded road on which the steepest incline shall not exceed six per centum, and the width of which shall be not less than twenty feet between side ditches, and which shall be properly drained, and have a wagon way or travel track not less than nine feet wide in the clear between curbs and which shall consist of a paving brick surface laid on gravel, sand, broken stone or slag: Proviso. Provided, however, That the quality of brick, manner of laying and the kind of inspection employed shall be made to comply with the specifications made by or approved by the state highway commissioner, shall merit, if approved by the state highway commissioner, a reward from the State of one thousand dollars per mile and pro rata for extra miles and fractions thereof in excess of the first mile, with an extra one hundred dollars per mile for each additional foot in width of brick roadway in excess of nine feet up to and including sixteen feet.

Am. 1911, Act 148; 1913, Act 355.

Reward limited in one year. SEC. 11. No claim for State reward for improved roads of over four miles in any one surveyed township in any one fiscal year shall be allowed by the state highway commissioner: Proviso. Provided, however, That if any township or county shall have raised money by tax or sale of bonds to build a mile or more of road such as merit State reward and the road shall be built and approved by the state highway commissioner, and this road is kept in as good condition as when approved by the state highway commissioner, such township or county shall have its application number remain upon the books of the state highway department, and draw from the State reward fund each year until such time as the township



The first view shows the old wooden bridge across Plaster Creek on South Division Street, Grand Rapids, Kent County.

The second and third views show completed reinforced concrete arch, built by the State Highway Department.

For details see Trunk Line Bridge Table, Contract Number 3, page 100.

or county has received the amount due for the class and the amount of road built.

Am. Id.

SEC. 12. The state highway commissioner is hereby given authority to refuse to grant any further road reward to any township or county that has been rewarded by the State for improving roads, that does not keep these State reward roads in proper repair, but upon his refusal to any township or county for an allotment of State reward, it shall be the commissioner's duty to inform such township or county of what repairs are necessary to place them in a position to again be eligible to receive State reward, and if these repairs are made satisfactory to the commissioner, he shall reinstate them to the eligible reward list: Provided, That if the township or county shall fail to make the repairs ordered by the state highway commissioner in a reasonable time after being so ordered, then shall the state highway commissioner cause such repairs to be made and pay for them out of the reward money earned by such township or county, after which the remainder of such money shall be paid to said township or county, which shall then become eligible to receive further State reward.

When reward may be refused.

Proviso.

Am. 1913, Act 355.

SEC. 13. The decision of the state highway commissioner shall be final, relative to whether the road is built well enough or not to merit State reward, and shall have the right to retain any amount of the reward he deems advisable until the road has been thoroughly tested.

Decision of commissioner, final.

SEC. 14. There shall be assigned to the state highway commissioner, by the board of state auditors, suitable rooms at Lansing, for the conducting of the business of the state highway department, and they shall provide suitable furniture and office equipment.

Office, etc.

SEC. 15. Whenever any township or county shall rebuild or widen the metaled surface of any road on which State reward has heretofore been paid, and thereby raise the standard from a lower class to a higher one, or from a narrow metaled track to a wider one, then shall such township or county be entitled to receive the difference between the reward already paid and the reward it would now be entitled to receive on account of such road, and had no former reward been paid: Provided, That application for increased reward shall have been made to the state highway commissioner before beginning the work of rebuilding or widening, and further, that such road shall have been rebuilt or widened in accordance with specifications furnished by, or approved by the state highway commissioner and accepted by him when completed.

Raise of standard.

Proviso.

Added 1913, Act 355.

Repair fund.

Sec. 16. On or before December first of each year a portion of the appropriation for State highway purposes, equal to two per centum of the total State rewards that may have been paid at that time, shall be credited to a repair fund which shall be paid out after December first of each year for repairs on State rewarded roads, in the same manner as State rewards are now paid: Provided, That such repairs shall have been made in accordance with specifications prepared by or approved by the state highway commissioner and that the amount so paid to any township or county shall not exceed two per centum of the total State reward money heretofore paid to such township or county, not counting any roads that may have been accepted and rewarded during the current calendar year.

Proviso.

Added Id.

STATE REWARD TRUNK LINE HIGHWAYS.

An Act to provide for the establishment, survey, improvement and maintenance of State reward trunk line highways, to provide for the payment of double State reward thereon, to define the duties of State, county, good roads district and township officers in regard thereto, and to appropriate funds to carry out the provisions thereof.

[Act 334, P. A. 1913.]

The People of the State of Michigan enact:

Establishment provided for.

Section 1. Provision is hereby made for the establishment of State reward trunk line highways. These highways which are laid out as hereinafter provided shall be improved, surveyed, maintained and rewarded in accordance with the provisions of this act.

Division into routes.

Sec. 2. The State reward trunk line highways shall be composed of the highways and bridges constituting the routes indicated in the following statement of divisions:

Division 1. Beginning near the southeast corner of the State and running to Monroe, Wayne, Detroit, Mt. Clemens, Marine City, St. Clair, Marysville, Port Huron, Lakeport, Blaine, Jeddo, Applegate, Carsonville, Downington, Deckerville, Ruth, Harbor Beach, with a branch from Port Huron to Avoca, Yale, Peck, Sandusky, Snover, Ubly, Bad Axe, Port Austin, and from Yale to Brown City, Burnside, Marlette, Clifford, Mayville, Vassar to Saginaw, with a subbranch from Burnside, North Branch to Lapeer.

Division 2. Beginning at Detroit on Woodward Avenue and running northwest via Pontiac, Holly, Fenton, Flint, Owosso, Saginaw, Bay City, Tawas City, Alpena, Onaway, Cheboygan, Mackinaw City; with a branch from Owosso to St. Johns, Ionia, Belding, Grattan, Grand Rapids, thence west on Fulton street to Lake Michigan, with a branch from Saginaw through Sebewaing, Pigeon, Elkton, to Bad Axe, and from Grand Rapids to Holland.

Division 3. Beginning at the south line of the State on the meridian line running north by Hudson, Addison, Jackson, Lansing, St. Johns, Ithaca, Alma, St. Louis, Breckenridge, to the prime meridian line, then north along said meridian line as near as practicable through the State to connect with division number two where said highway crosses the meridian, with a branch from Alma north to Mt. Pleasant, Clare, Harrison, Leota, Star City, Moorestown, Kalkaska.

Division No. 4. Beginning at White Pigeon running north to Three Rivers, Schoolcraft, Kalamazoo, Grand Rapids, Howard City, Big Rapids, Reed City, and Cadillac to Traverse City, with a branch from Cadillac to Manton, Walton Junction, South Boardman, Kalkaska, Mancelona, Alba, Elmira, Boyne Falls, Walloon Lake and Petoskey.

Division No. 5. Beginning at the State line south of Niles, running north through Niles, St. Joseph, Benton Harbor, Watervliet, also from New Buffalo through Stevensville to St. Joseph, South Haven, Holland, Grand Haven, Muskegon, Whitehall, Shelby, Hart, Pentwater, Ludington, Scottville, Manistee, Traverse City, Elk Rapids, Charlevoix, Petoskey, Pellston, Mackinaw City, with a branch from Scottville to Reed City, Evart, Clare, Midland and Bay City, with a branch from Manistee through Arcadia, Frankfort, Empire, Glen Haven, Leland, Northport, Omena, Sutton's Bay to Traverse City, with a branch from Muskegon through Holton, Reeman, Fremont, Wooster, White Cloud, Woodville to Big Rapids.

Division No. 6. Beginning on Michigan Avenue in Detroit, via Wayne, Ypsilanti, Ann Arbor, Chelsea, Jackson, Albion, Marshall, Battle Creek, Kalamazoo, Paw Paw, Hartford, Watervliet; with a branch from Battle Creek to Hastings to Irving to Middleville (via the river road), to Caledonia to Grand Rapids.

Division No. 7. Beginning at Saint Ignace and running westward to Manistique, Masonville, Gladstone, Escanaba, Spalding, Iron Mountain, Crystal Falls, Iron River, Watersmeet, Bessemer to Ironwood; with a branch from Spalding to Menominee; also a branch from Saint Ignace to some point north of Saint Ignace, thence through Pickford to Sault Ste. Marie, over a route to be designated by the state highway commissioner.

Division No. 8. Beginning at Escanaba and running northerly to Marquette, thence to Negaunee, Ishpeming, Michigamme, L'Anse, and Baraga to Calumet, to Eagle River, with a branch line from Houghton to Ontonagon.

Division No. 9. Beginning at the city limits of Detroit on Grand River avenue, and running northwesterly to Redford, Farmington, New Hudson, Brighton, Howell, Fowlerville, Webberville, Williamston, East Lansing, Lansing, Grand Ledge, Portland and Ionia, with a branch running westerly through Mulliken, Sunfield, Lake Odessa, then westerly to connect with the county road of Kent county, about two miles north of the south county line of Kent county.

Division No. 10. Beginning at Ann Arbor, running to Whitmore Lake, Hamburg, Lakeland, Pinckney, Anderson, Gregory, Stockbridge, Fitchburg and connecting with the main line at or near Leslie: Provided, That upon petition of two or more contiguous counties through their boards of county road commissioners in counties under the county road system, or through their boards of supervisors in other counties, or upon his own action, the state highway commissioner shall make preliminary surveys and such other investigations as he shall deem necessary of one or more routes for State reward trunk line highways, through such counties. After investigation the state highway commissioner shall submit to such county road commissioner, boards of supervisors, good roads district commissioners or township boards as the case may be, maps showing feasible routes and approximate estimates of cost of building over each of said routes, when the said boards shall concur upon one of such routes which shall then be known as a part of the State reward trunk line highway system. The maximum number of miles of trunk line highways which may be established in any county, shall be computed by multiplying the number of surveyed townships by three, fractional townships to be computed pro rata.

Proviso, investigation of routes.

Notice of arrangements.

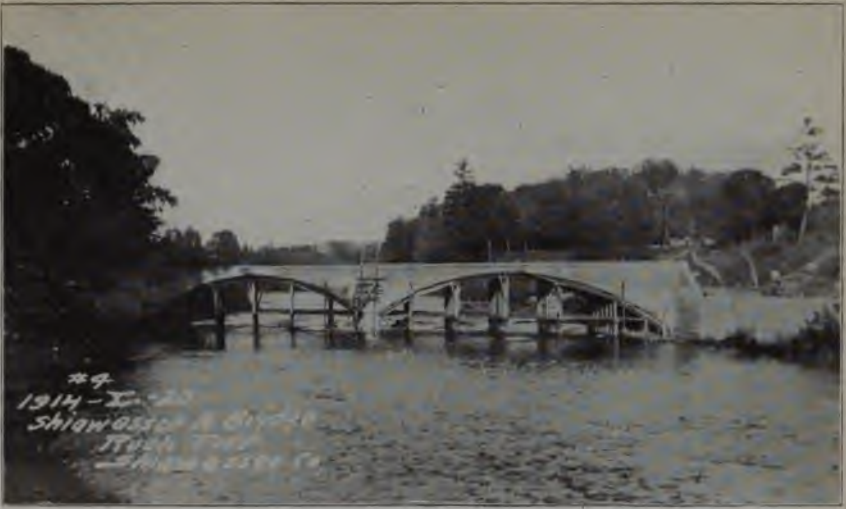
Sec. 3. Whenever any county, good roads district or township shall file notice with the state highway department through its proper officers that arrangements have been made or sufficient funds raised to improve three miles or more of road which is a part of the State reward trunk line highway system previously established according to the provisions of this act, and shall ask for survey, plans and specifications, and shall make application for State reward under provisions of this act, it shall be the duty of the state highway commissioner to enter such application and cause the road to be surveyed and have plans and specifications prepared. When any county under the county road system, or good roads district or township shall build two miles or more of such road, the same shall be inspected by an engineer under the directions of the state highway commissioner, and if found to be up to the required standard, shall be entitled to and paid double the legal State reward as provided and specified in chapter five, act number two hundred eighty-three of the public acts of nineteen hundred nine, as amended or as may hereafter be amended.

Application for reward.

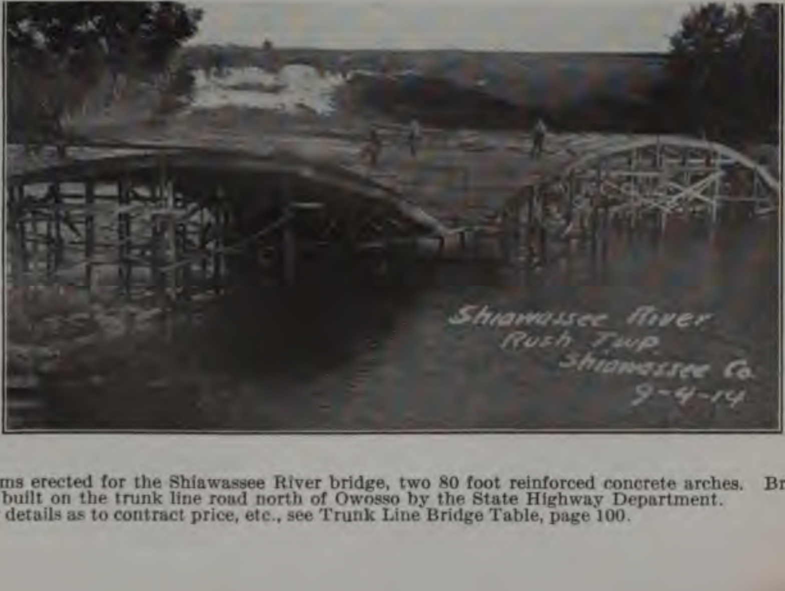
Double state reward.

Bridges, etc.

Sec. 4. The state highway department shall design all bridges and culverts and construct all bridges greater than thirty-foot clear span on State reward trunk line highways:



Shiawassee River Trunk Line Bridge with forms partly removed. This view was taken before the rails were built.



Forms erected for the Shiawassee River bridge, two 80 foot reinforced concrete arches. Bridge is being built on the trunk line road north of Owosso by the State Highway Department.

For details as to contract price, etc., see Trunk Line Bridge Table, page 100.

Provided, That no bridges shall be constructed before the county, good roads district or township has funds available to construct at least three miles of road which includes the bridge site. Proviso, funds.

SEC. 5. Old State reward roads, which are or become a part of the State reward trunk line highway system, shall be, if in perfect repair, entitled to one-half additional State reward, or if such old rewarded roads be widened or resurfaced, or both, then shall the county, good roads district or township be entitled to an added reward equal to the difference between the reward paid and the legal reward under this act. Old state reward roads.

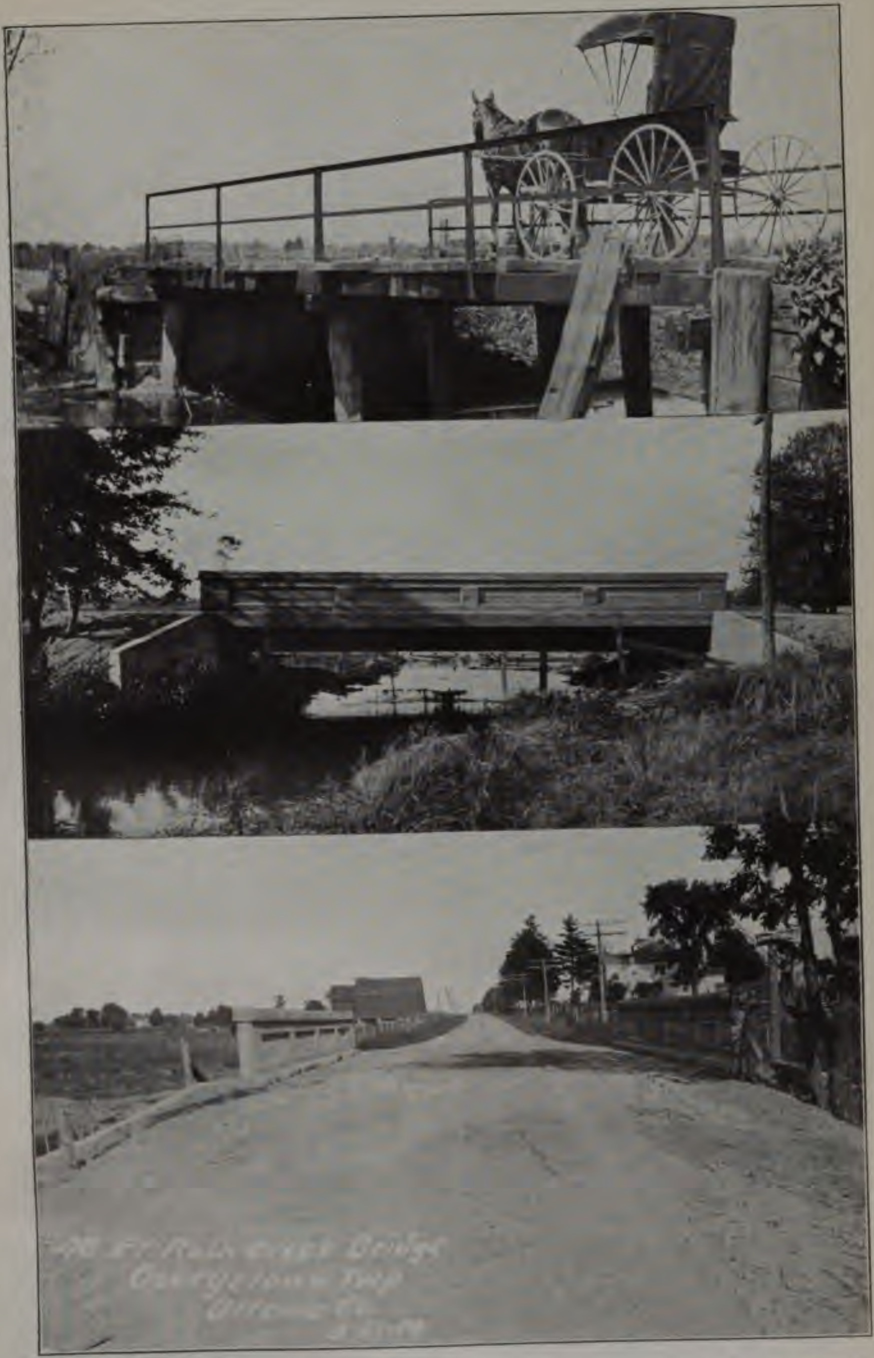
SEC. 6. The state highway commissioner is hereby given the authority to refuse to grant any further trunk line road reward to any township, good roads district or county that has been rewarded by the State for improving roads that do not keep these trunk line rewarded roads in repair, but upon his refusal to any township, good roads district or county for an allotment of trunk line reward, it shall be the commissioner's duty to inform the proper officials of what repairs are necessary to place them in a position to again be eligible to receive trunk line reward, and if these repairs are made satisfactorily to the commissioner, he shall reinstate them to the eligible trunk line reward list: Provided, That if no reward is due said county, good roads district or township, then the state highway commissioner is given authority to make the necessary repairs and to render a bill for the repairs to the proper officers of such county, good roads district or township. This bill shall be paid upon the warrant of such officers, and the supervisors shall include the amount in the next regular tax roll. Refusal of reward. Reinstatement. Proviso, repairs and bill for same.

SEC. 7. There is hereby appropriated for the state highway department for the fiscal year ending June thirty, nineteen hundred fourteen, the sum of two hundred thousand dollars, and for the fiscal year ending June thirty, nineteen hundred fifteen, the sum of three hundred thousand dollars, which shall constitute a fund for the payment of the additional State reward on trunk line highways, building or repairing bridges on such highways, and paying the salaries and running expenses incurred by this act. Any moneys remaining in this fund at the close of any fiscal year shall be carried over by the auditor general and added to the funds which become available for the following year. Appropriation. Surplus.

SEC. 8. The auditor general shall incorporate in the State tax for the year of nineteen hundred thirteen, the sum of two hundred thousand dollars, and for the year of nineteen hundred fourteen, the sum of three hundred thousand dollars, which amount, when collected, shall be credited to the general fund to reimburse the same for moneys hereby appropriated. Tax clause.

Preliminary surveys.

SEC. 9. The state highway commissioner shall as soon as practicable after the taking effect of this act cause preliminary surveys to be made and establish the routes of the several divisions of the State trunk line highways herein provided for, and he is hereby empowered to employ such engineers, clerks and other employes as may be necessary to carry out the provisions of this act.



40 foot trunk line bridge in Georgetown Township, Ottawa County, constructed by the State Highway Department.

Upper view shows the old bridge which became unsafe.

Second is a side view showing outside of concrete rails, wing walls, etc.

Reinforced concrete construction was used on the floor and rails, 5 lines 24 inch-80 lb. I-beams for the girders.

Contract price and other details can be found in Trunk Line Bridge Table, Contract Number 6, page 100.

HOW TO MAKE APPLICATION FOR STATE REWARD.

In order to aid township and county officials in making application for reward, this department offers the following:

ORDINARY STATE REWARD.

To obtain State Aid in the building of ordinary reward roads, that is roads that do not fall on established trunk lines, it is necessary for the Township Board or Board of County Road Commissioners to meet and adopt a resolution making the application. This application is to be made on regular forms furnished by this department upon request. For townships Form AP2 is used while for counties AP1. (See Plate). The following should be noted in making out these forms:

In the blank following the word, "Class" the letter indicating the material to be used must be inserted. (For specification of different classes see pages 55-80). In the blank preceding the word "Feet," the width of the metal track should be inserted and not the width of turnpike. In describing the road the point of beginning should be referred to by section corners and ¼ posts. The direction of the road should be given with distances and the crossing of section or ¼ lines should also be noted. The point where the road terminates should be referenced by bearing and distances to some known government corner. In signing the application each member of the Township Board should place after his name the office he is holding and in the case of the Board of County Road Commissioners, the Chairman of the Board should add the word "Chairman" after his name. The road to be improved should be platted on back of application sheet.

Along with this application, the township or county as the case may be, must file a profile. This profile must be made from a survey of the road to be improved, by a competent engineer or surveyor. When the profile and application are approved by this department, the township or county will receive detailed acknowledgment. This notice will be their authority to start work according to specifications which will be sent with the same.

TRUNK LINE REWARD.

Application for trunk line reward can be made only on such lines as have been heretofore established by concurrent action of local officials and the State Highway Commissioner.

As in the case of making application for ordinary reward, it will be necessary for the Township Board or Board of County Road Commissioners to adopt a resolution that application be made for trunk line reward. This application should be made out on regular forms furnished by this department upon request. The description of road in a trunk line application should contain all the features of the description in an ordinary application. When this application properly filled out and signed is received by this department arrangements will be made for a survey. This survey together with profile will be made by this department without expense to the township or county. As soon as the profile and plans can be made, they will be forwarded to you along with specifications for the work.

WIDENING AND RESURFACING OF ORDINARY REWARDED ROADS.

Whenever the Township Board or Board of County Road Commissioners wish to rebuild and widen an old rewarded road and receive the additional reward, they should adopt a resolution to that effect. Then write the State Highway Department describing the road to be improved and ask to have the proper blanks forwarded, ready to sign.

WIDENING AND RESURFACING ROADS LOCATED ON THE TRUNK LINE.

To obtain additional reward for widening and rebuilding a road located on the trunk line, it will be necessary for the Township Board or Board of County Road Commissioners to adopt a resolution applying for the additional reward, survey and plans, and specifications. When this department receives the application, the survey will be arranged for, plans and specifications prepared and forwarded to the proper officials.

Form AP2.
2000—7-13

Application for Use Only by Township for Ordinary Reward.

STATE HIGHWAY COMMISSIONER,
Lansing, Michigan.

SIR:—

At a meeting of the **Township Board** of the township of Central Lake county of Antrim held this Fourth day of May 1912, the following resolution was adopted.

"Resolved that in accordance with Ch V, Act 283 of the Public Acts of 1909 as amended, the township of Central Lake build 1.218 mile~~s~~ of road as specified in Class B, 9 feet wide, under section ten of said chapter and act as amended; that application be made for state reward in the sum of $ 500 per mile for aid in the construction thereof; that the improvements on said road shall commence at the intersection of the East and West One-quarter line of Section 16, with the East one-eighth line of said section; thence north on one-eighth line to east one-eighth post common to sections 9 and 16; thence west on section line between sections 9 and 16, 353 ft. thence northwesterly 2640 ft. to a point 1420 ft. south and 1500 ft east of one-quarter post common to sections 8 and 9, a total distance of 1.218 the same being a leading public wagon road; that a profile of the present road and plan of the proposed changes be made by a competent surveyor; that copies of this resolution and of the profile and plan be forwarded to the State Highway Commissioner at Lansing; and that he be requested, if same are satisfactory, to furnish outline plans and general specifications required in the construction of said road."

We hereby certify that no part or parcel of the portion of road covered by this application lies within the incorporated limits of any city or village, and that no state reward has heretofore been paid upon any part of said portion of road.

Dated May 4, 1912
at Central Lake Michigan.

Township Board.

Thos M. Rushton, Clerk
O. H. Sage, Sup'r
H. F. Blakely J.P.
Fred Roman J.P.

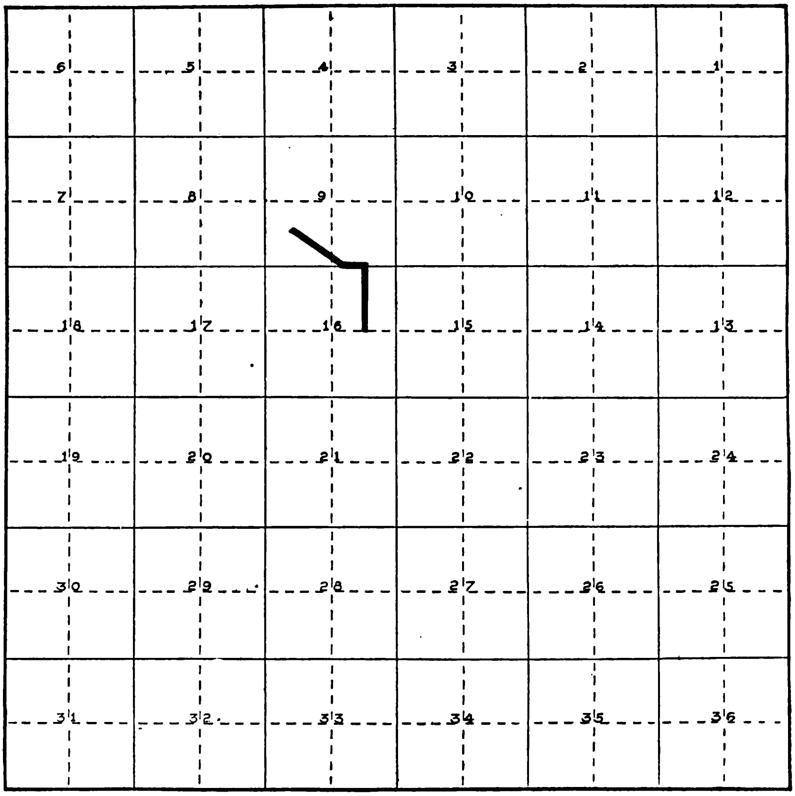
Plat road covered by application, on back of this sheet.

County Antrim

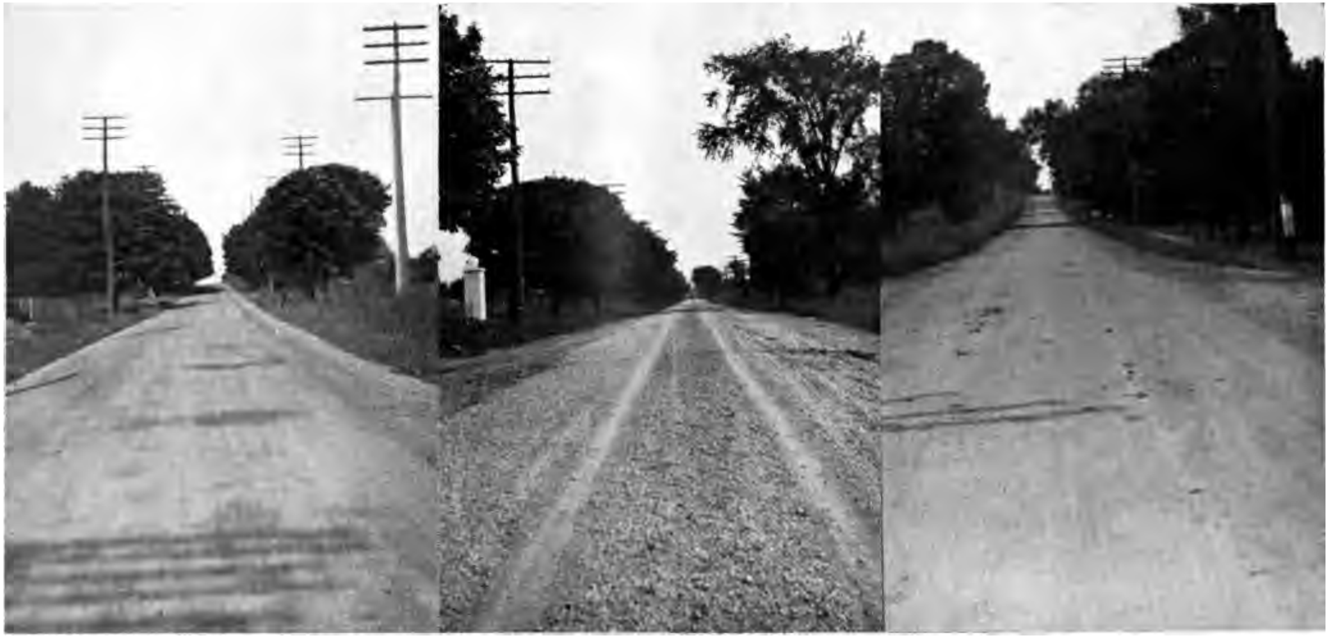
Township Central Lake

Town 31 North

Range 8 West



Application blanks furnished upon request, by State Highway Department, Lansing, Michigan.



Jackson County Trunk Line Roads.
Left-hand view shows Wildwood Avenue Road built in 1913.
Center view shows Wildwood Avenue Road built in 1914. Gravel not thoroughly compacted.
Right-hand view shows East Main Street Road built in 1913.
Roads built by Jackson County Road Commission.

HOW TO USE ROAD PLANS AND PROFILES.

The plans and profiles for State Reward Trunk Line Roads are, under the law, made by the State Highway Department, the construction work on the road being done in accordance with these plans by the local township or county officials. In explanation of these plans we offer the following:

SURVEY.

The engineer who surveys the road, stakes it out permanently with two lines of hubs and markers set uniformly 25 feet back from the center line of the road, marking lines which are parallel to the center line. The hubs are small stakes about 1½-inches square, while the marker is a larger stake set back of the hub. (See plan on page 53.)

PLAN.

The drawings are made on cross section cloth in which the large squares measure one inch and the small ones one-tenth inch. Across the top of the sheet are the numbers representing the hubs or "stations," as they are called, together with any distances noted between hubs which are written +; for instance, 26 + 50 means 50 feet from hub number 26, *measured in the direction of hub number 27*. Immediately below this line of numbers is located the plan of the road. On the plan are shown the location of cross roads, curves, culverts, guard rails, telephone poles and trees, United States land corners, buildings, etc., which are found within the boundaries of the road, as shown by the heavy lines or the light lines designating fences. Outside of the road lines are shown the farm buildings, creeks, ponds and other general features of the topography which may affect the grade of the road. Farm entrances of importance are shown.

PROFILE.

Below the road plan in the center of the sheet is the road profile. The center one of these profiles shows in a light irregular line the surface of the present road before grading. The even heavy line on the same base shows the new center line grade of finished road. The center line cuts and fills are shown directly above these two lines, marked (F) for fill and (C) for cut, which measurements are the actual measurements from the road as surveyed to the top of the finished road. The distance the finished center line is above the hubs, (marked +), or below the hubs, (marked —), on either side, is shown by the figures directly above the actual cuts and fills and directly below the center line profile. One line of figures being references to each hub line. To get the elevation of sub-grade one should go the depth of the metal below the point given by these figures. All figures on these plans are given in feet and tenths of feet. This enables the foreman or commissioner to refer his center line cuts and fills to hubs after grading operations have commenced.

Directly above the center line profile is found the ditch and hub profiles for one side. The light dotted line is the hub profile which is 25 feet back from the center line of the road. The uneven light line shows the present line of ditch or side profile of the road, and the heavy dark line is the proposed new ditch or gutter line. The figures right above these lines are the distances below the hub line, to which the bottom of completed ditch or gutter is to be dug. This also applies to the other ditch or gutter and hub line shown on the lower profile.

If any question arises as to what any profile line or figures refer to, see notes on left end of each sheet.

LAYING OUT WORK.

Before starting grading operations the commissioner or foreman should go over the line of the road with the profile in hand, and set side grade stakes for all points where a fill is shown. These stakes should be of correct length to drive in the ground so that the top will be just even with the finished grade. Then, as the work progresses, a sight can be taken across the tops of these stakes to tell how much more fill is necessary.

In cuts it is wise to keep track of plowings and the approximate depth of each, so as to tell when you are within 10 or 12 inches of sub-grade. Then dig a hole in the center of the road and drive a stake so that the top of it will be just flush with the sub-grade elevations. By these two methods, workmen can then be instructed to cut until down even with the top of the stake, and fill until up even with the top of the fill stakes.

For a convenient, cheap instrument for making these measurements we would suggest the use of a 10-foot pole, marked off in feet and tenths of feet, and a Mason's line level. See plan on page 53. These levels may be procured at hardware stores.

SPECIAL FEATURES.

Culvert plans and small bridge plans are transmitted with each set of profiles for the necessary work along the line of that particular road. Wooden guard rails are specified for each unprotected fill which is more than six feet in height. The plans for these guard rails are shown on the road plan, and should be built of good cedar posts with sound, straight grained 2 x 6 rails. Guard rails should be painted with three coats of good white lead.

Finally we solicit correspondence relative to any point on plans or specifications which is not fully understood.

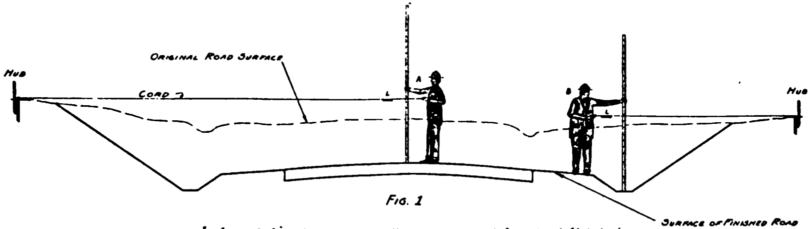


FIG. 1

In figure 1 "A" is shown checking the measurement from the left hub stake to the finished grade. In his left hand he is holding a cord which is attached to the top of the hub stake, by means of a nail. The cord is kept level by mean of an attached level vial at L. In his right hand he is holding a rod graduated to feet and tenths. The reading shown by the cord on the rod should be the same as the figure shown on the profile for that station.

"B" is shown checking the cut to the right ditch grade from the right hub in a similar manner.

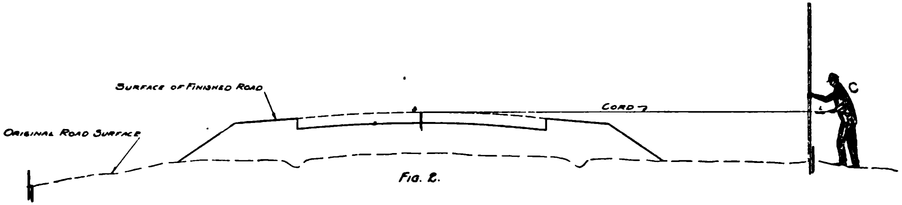


FIG. 2.

In figure 2 "C" is shown checking the fill for the sub-grade. A stake "S" has been driven in the center of the road projecting 8 inches (for Class B) above the surface. In his left hand the man holds a cord with a level vial attached. The cord is also attached to top of stake "S". With his right hand he holds a rod, graduated to feet and tenths, on top of the hub stake. With the cord kept level the reading on the rod should be that given on the profile for that station.

MICHIGAN STATE HIGHWAY DEPARTMENT
FIGURES SHOWING METHODS
OF
TAKING MEASUREMENTS FROM HUB STAKES
DRAWN BY Curtiss AUG. 29, 1913.
APPROVED BY Leroy C. Smith
SCALE 1/4" = 12" Deputy Commissioner.

SURVEYORS AND ENGINEERS

Making surveys and plans for state reward roads should give the following suggestions careful attention:

(1) In establishing center line of road, section and quarter corners must be found in place. If no permanent monument exists, corners must be established in accordance with rules of the Government survey and permanent monuments set.

(2) Stakes with hubs should be set one hundred feet apart along each side of the proposed roadway, uniformly twenty-five feet from the center line of the same.

(3) Levels should be taken at each station: (a) on the center line, (b) on the hub at each side stake, (c) in the bottom of each ditch, if there are any ditches. Plus levels should be taken on railroad tracks, on the floors of culverts and bridges, in the beds of streams that serve as outlets for road ditches, and at such other points as the surveyor may deem necessary.

(4) The plan and profile should be placed on the same sheet, projecting the plan vertically above or below the profile. Angles in the line may be indicated by the use of broken lines or small circles, giving the bearings and distances in figures without attempt at laying out with a protractor.

(5) The plan must contain a description in sufficient detail so that the road can be platted on township maps. The description must refer to section lines, quarter lines, section corners, quarter corners. Exact location of point of beginning with bearings and distances of the survey to the terminal must be given. In case of angling roads, where center line crosses section or quarter section lines, the station and plus at intersection and the distance from such intersection to the nearest section or quarter section corner should be noted on the profile. Permanent monuments to be set on center line at all angles.

(6) One hundred feet to the inch horizontal and five or ten feet to the inch vertical are desirable scales. No smaller scale than two hundred feet to the inch horizontal and twenty feet to the inch vertical will be allowed. Vertical and horizontal scales should always be noted on the profile.

(7) The profile must show at each station: (a) center line cuts and fills in figures, (b) the depth of each ditch or gutter in figures from the outer side hubs, (c) the distance in figures of the established grade above or below each line of side hubs. Tabulated cuts and fills on separate sheets are not desirable and will not be accepted in lieu of the profile. Cuts and fills should balance.

(8) Grade line should show elevation of finished road and not the sub-grade. Points of change in proposed grade line should not be made abrupt, but angles should be rounded off with vertical curves. Avoid, if possible, the use of level grade line. At least six inches incline to one hundred feet is desirable. Elevations of stations at change points should be given referring to located bench marks.

(9) A complete working profile should show: (a) center line profile, (b) profile of each side ditch or gutter, (c) all the figures required to build the complete road as staked out.

(10) A typical cross-section should be shown. State law requires that turnpike be at least twenty feet between and exclusive of side ditches with an average crown of one inch to one foot.

(11) At least three sets of plans must be prepared, one for filing with the township or county clerk, one for filing with the State Highway Department, together with the application for reward, and one for use of commissioner or foreman doing the work. Surveyors and engineers should provide themselves with application blanks for state reward roads and fill in description ready for the signing of the township board or county commissioners.

(12) All profiles must be approved by township boards or county road commissioners, before filing with the State Highway Department.

(13) It is desirable to prepare the original profile on tracing cloth, the surveyor or engineer retaining it, and as many prints as may be required can be furnished the township or county. Profile tracing cloth, Standard cross-section 10 x 10, is very convenient for this class of work and is recommended by the State Highway Department.

(14) Profiles, which do not in the main comply with these requirements, will be returned for corrections to the surveyor or engineer making the same. No application for state reward will be filed by the State Highway Department until both profile and application are approved by the Commissioner.

GENERAL SPECIFICATIONS FOR ROADS—CLASS A.

(LOW TEST GRAVEL), (CLAY-SAND) OR (ONE COURSE GRAVEL).

Section 10, Chapter V, Act No. 283, Public Acts 1909 as amended.

If good gravel is obtainable within a reasonable haul, say three miles, there is no economy in class A construction, except for the one course gravel road, and at best a clay-sand road does not rank with a gravel road. The construction cost of a clay-sand road varies from one thousand to as high as eighteen hundred dollars per mile. The higher cost, it can be seen, does not vary much from the cost of gravel roads. Townships and counties desiring to construct this class of road should place their application in the hands of the State Highway Department early in the season so that an engineer can be sent over the ground where the road is proposed to be built and recommend the quality of clay and sand or the grade of gravel which is to be used.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

Grading.—The roadway shall be graded so as to strictly conform to the plans and specifications for the road in question, heretofore submitted to and approved by the State Highway Commissioner. The finished road shall be not less than twenty feet between and exclusive of side ditches or gutters and have a cross-section oval in form, with an average rise of one inch to the foot from the inner edge of such ditch or gutter to the center line of the road. In general, earth for fills should be taken from cuts. In no case shall deep unsightly ditches be cut along the roadside for the purpose of making fills. For more details as to the manner of forming grades and ditches see cut on page 69.

Drainage.—The side ditches and gutters shall be of such size as the drainage requirements of the locality demand, and must be formed with true grades, having sufficient incline to cause a free and uniform flow of water to the nearest natural outlets, which outlets must be so improved where necessary as to carry the water quickly away from the highway. The slope of the banks of ditches shall be not steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed, at such places, of such kind and size and on such grades as may be shown on the plans.

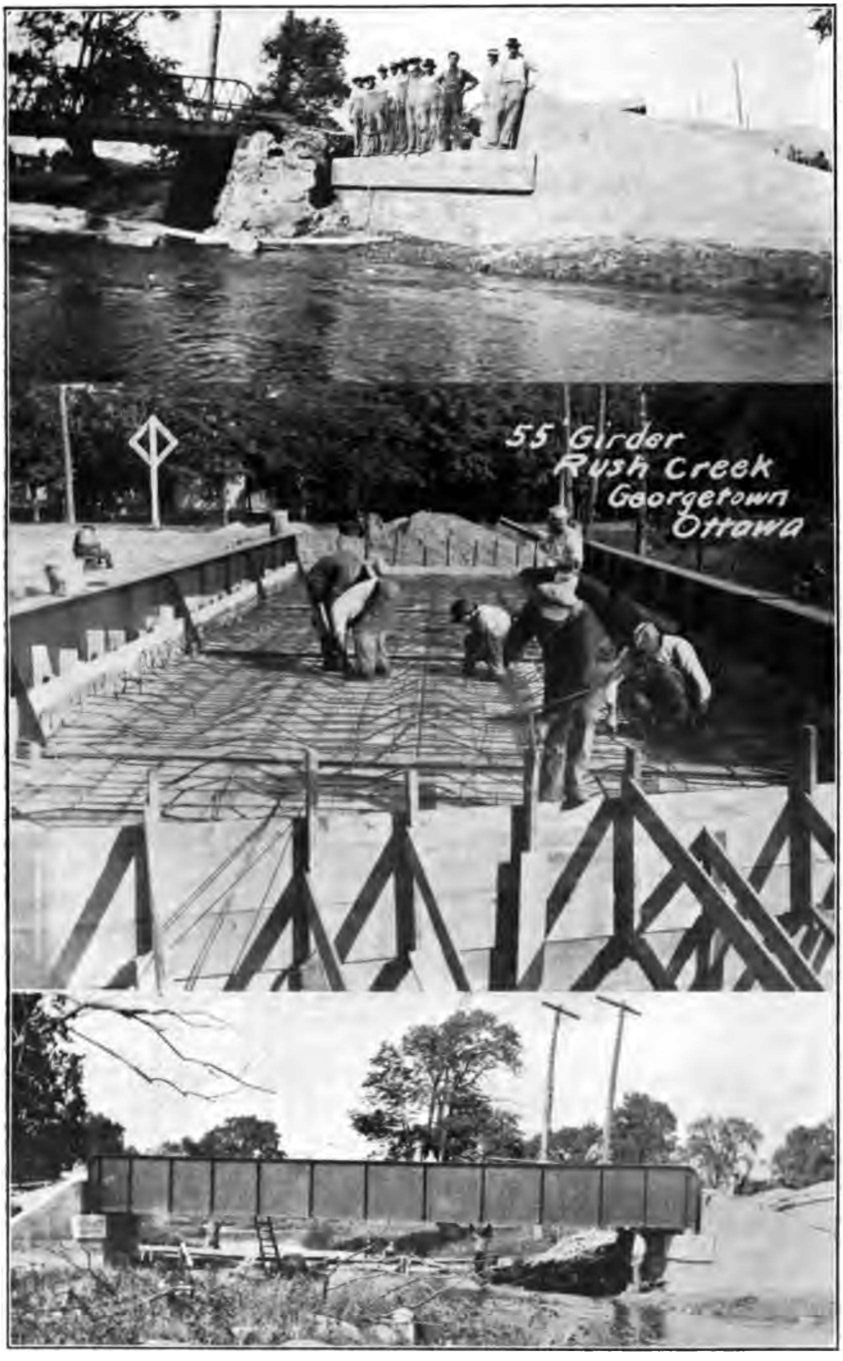
In clay soils trenches shall be cut through the shoulders, described in the next paragraph, making outlets into the side ditches for water that may collect in the metal bed during construction and later before the surface becomes hard and water-proof. Such trenches shall be eight inches or more in width and slightly deeper than the metal bed. They shall be placed at all low points in the grade and not farther than one hundred feet apart in retentive soils and must be filled with gravel or other porous material when the first layer of metal is being applied.

Metal Bed and Shoulders.—After the road has been graded as above described the metal bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth, or other suitable material shall be placed on each side of the metal bed not less than nine feet apart or such greater distance as may be required to retain the width of metal specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides, or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center, or, if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

After the road has been graded, one of the three following forms of construction for metal track must be used. Use the one which will give the best construction with materials which may be had locally.

(1) FORTY PER CENT GRAVEL ROAD.

First Course of Gravel.—After the road has been graded in the manner above described, a layer of gravel shall be spread on the prepared bed to such uniform thickness as to be not less than five inches deep after compacting, six inches deep, loose measure. The gravel for this course shall consist of good, clean bank gravel, not less than forty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of two and one-half inch mesh. *If the road bed and shoulders are naturally sandy, clay gravel shall be used; if road bed*



Three views of a 55 foot trunk line bridge in Ottawa County, built by the State Highway Department
The upper view shows one of the abutments completed. At the left will be seen the old steel bridg and stone abutment wall.
The second view shows the roadway; men are placing reinforcing steel for concrete floor.
Lower view shows a side elevation of the heavy steel plate girders after completion.
For details, see Trunk Line Bridge Table, Contract Number 5, page 100.

and shoulders are naturally heavy soil, sharp, sandy gravel shall be used. The gravel shall then be harrowed with a spike tooth harrow and rolled until no further compacting is possible. The rolling must be done only when the road has been well wetted by sprinkling or after rains. Any hollows that may develop in the gravel during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniformly smooth and hard and everywhere parallel to and three inches below the surface of the finished road. The crown can be preserved during construction by the occasional use of the grader or other suitable floating tools. Ruts formed by hauling over the gravel shall be kept filled by using the harrow twice or more every day, preferably just before quitting time both noon and night.

Second Course of Gravel.—The gravel for the second course shall consist of good, clean bank gravel forty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and will pass through a screen of one and one-half inch mesh. Other requirements for gravel in this course are the same as specified for gravel in the first course. This gravel shall be spread on the road to such uniform thickness as to be not less than three inches deep after compacting, four inches loose measure, after which it shall be harrowed and rolled in the same manner as prescribed for the first course. Any depressions that may be formed during the rolling shall be filled with the kind of gravel prescribed for the second course and the road re-rolled until the surface is uniformly smooth and hard and everywhere conforms to the proposed grade and cross-section of the road.

(2) ONE COURSE SIXTY PER CENT GRAVEL ROAD.

Course of Gravel.—After the road has been graded and rolled in the manner above described, a layer of gravel shall be spread on the prepared bed to such uniform thickness as to be not less than five inches deep after compacting, six inches deep, loose measure. The gravel shall consist of good, clean bank gravel, not less than sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of two inch mesh. The gravel course shall then be harrowed with a spike tooth harrow and rolled until no further compacting is possible. The rolling must be done only when the road has been well wetted by sprinkling or after rains. Any hollows that may develop in the gravel during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniformly smooth and hard and conforms to grade of the finished road. The crown can be preserved during the construction by the occasional use of the grader or other suitable floating tools. Ruts formed by hauling over the gravel shall be kept filled by using the harrow twice or more every day, preferably just before quitting time both noon and night.

(3) CLAY-SAND ROAD.

First Course Clay.—Four inches of clay should be placed between the shoulders which have been previously prepared, taking care to spread it uniformly nine feet wide; over this should be crowded with the grader sufficient sand from the gutters and shoulders to make about three inches. This material should be thoroughly harrowed with a disc harrow until the sand nearly disappears into the clay and the clay works to the top, when it should be sprinkled or advantage taken of rains before rolling.

Second Course.—After the first course has been completed, another layer of clay shall be spread on the road to nine feet in width, two inches thick. Then sand from the sides should be crowded in with the grader and the whole course thoroughly sprinkled and disc harrowed together until a smooth, even surface is obtained, which will shed water and will not mud under heavy rains, nor disintegrate in dry weather. As the road is worn and rutted with travel, additional sand can be drawn in from the sides, the tendency of the clay on the bottom course being to come to the surface and mud.

Manner of Rolling.—Rolling shall be done only when the gravel has been thoroughly wetted by sprinkling or recent rains, and shall at all times begin at the sides, rolling lengthwise of the road, but gradually working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch and the whole road grade left in such perfect condition that water will flow without obstruction to the side ditches. Rolling may be done with a power roller, a heavy horse roller or a traction engine followed by a weighted field roller, if one of suitable strength to bear weighting to three or more tons can be obtained.

With any kind of a roller the spike-tooth harrow, preferably of the lever type, should be used as long as the teeth will penetrate the surface.

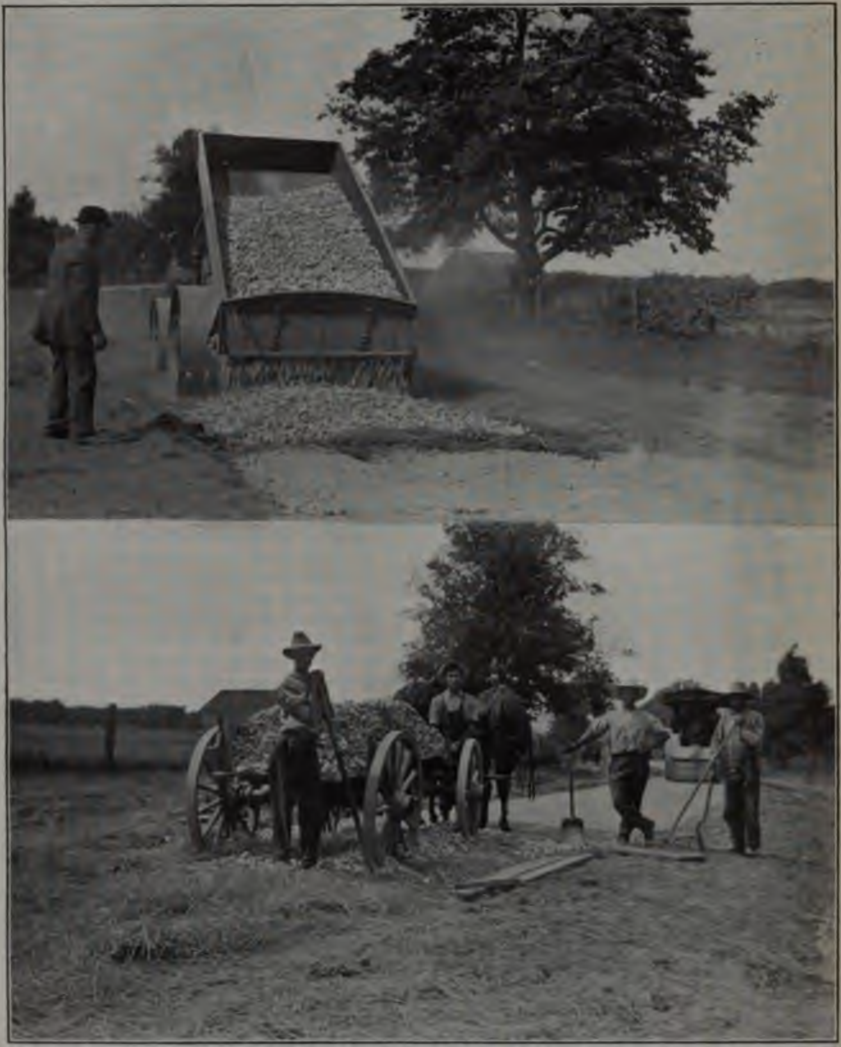
GENERAL SPECIFICATIONS FOR ROADS—CLASS B.

Section 10, Chapter V, Act No. 283, Public Acts 1909 as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

Grading.—The roadway shall be graded so as to strictly conform to the plans and specifications for the road in question, heretofore submitted to and approved by the State Highway Commissioner. The finished road shall be not less than twenty feet between and exclusive of side ditches or gutters and have a cross-section oval in form, with an average rise of one inch to the foot from the inner edge of such ditch or gutter to the center line of the road. Twenty feet is too narrow for the roadways of heavily traveled roads, and the State Highway Department recommends that turnpikes be made from twenty-two to twenty-four feet wide where the travel is heavy. In general, earth for fills should be taken from cuts. In no case shall deep unsightly ditches be cut along the roadside for the purpose of making fills. For more details as to the manner of forming grades and ditches see cut on page 69.

Drainage.—The side ditches and gutters shall be of such size as the



These two views show the dumping of the first course of stone on a Berrien County Road built under the direction of the Berrien County Road Commission. Take note of the marsh hay which is being used on top of the sub-base before the stone is applied to keep stone from mixing with the sand before it is thoroughly compacted.

drainage requirements of the locality demand and must be formed with true grades, having sufficient incline to furnish a free and uniform flow of water to the nearest natural outlets, which outlets must be so improved, where necessary, as to carry the water quickly away from the highway. The slope of the banks of ditches shall be not steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed at such places and of such kind and size and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders described in the next paragraph, making outlets into the side ditches for water that may collect in the gravel bed during construction and later before the surface becomes hard and water proof. Such trenches shall be eight inches or more in width and slightly deeper than the gravel bed. They shall be placed at all low points in the grade and not farther than one hundred feet apart in retentive soils and filled with coarse gravel when the first layer of gravel is being applied.

Gravel Bed and Shoulders.—After the road has been graded as above described the gravel bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth or other suitable material shall be placed on each side of the gravel bed not less than nine feet apart or such greater distance as may be required to retain the width of gravel specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center, or, if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-Grade.—After the shoulders and gravel bed have been formed as above described the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge and the roadway again rolled and left in solid and firm condition everywhere parallel to the finished roadway, the metal bed being eight inches below the finished grade and having the same crown. In deep mealy sand, where rolling is impracticable when subgrade is shaped, marsh hay, wet straw or fine brush shall be laid on subgrade to prevent the first course of gravel from mixing with the sand.

First Course of Gravel.—After the road has been graded and rolled in the manner above described, a layer of gravel shall be spread on the prepared bed to such uniform thickness as to be not less than five inches deep after compacting, six inches deep, loose measure. The gravel for this course shall consist of good, clean bank gravel, not less than sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of two and one-half inch mesh. If clay gravel is used, it should contain only clay enough to coat the pebbles, no free lumps. In no case should the clay exceed ten per cent of the mass, for clay makes mud and adds no wearing qualities. The gravel course shall then be harrowed with a spike tooth harrow and rolled until no further compacting is possible. The rolling must be done only when the road has been well wetted by sprinkling or after rains. Any hollows that may develop in the gravel during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniformly smooth and hard and everywhere parallel to and three inches below the surface of the finished road. The crown can be preserved during construction by the occasional use of the grader or other suitable floating tools. Ruts formed by hauling over the gravel shall be kept filled by using the harrow twice or more every day, preferably just before quitting time both noon and night.

Second Course of Gravel.—The gravel for the second course shall consist of good clean bank gravel, sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and will pass through a screen of one and one-half inch mesh. Other requirements for gravel in this course are the same as specified for gravel in the first course. This gravel shall be spread on the road to such uniform thickness as to be not less than three inches deep after compacting, four inches loose measure, after which it shall be harrowed and rolled in the same manner as prescribed for the first course. Any depressions that may be formed during the rolling shall be filled with the kind of gravel prescribed for the second course and the road re-rolled until the surface is uniformly smooth and hard and everywhere conforms to the proposed grade and cross-section of the road.

Manner of Rolling.—Rolling shall be done only when the gravel has been thoroughly wetted by sprinkling or recent rains, and shall at all times begin at the sides, rolling lengthwise of the road, but gradually working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch and the whole road grade left in such perfect condition that water will flow without obstruction to the side ditches. Rolling may be done with a power roller, a heavy horse roller or a traction engine followed by a weighted field roller, if one of suitable strength to bear weighting to three or more tons can be obtained.

With any kind of a roller the spike-tooth harrow, preferably of the lever type, should be used as long as the teeth will penetrate the surface.

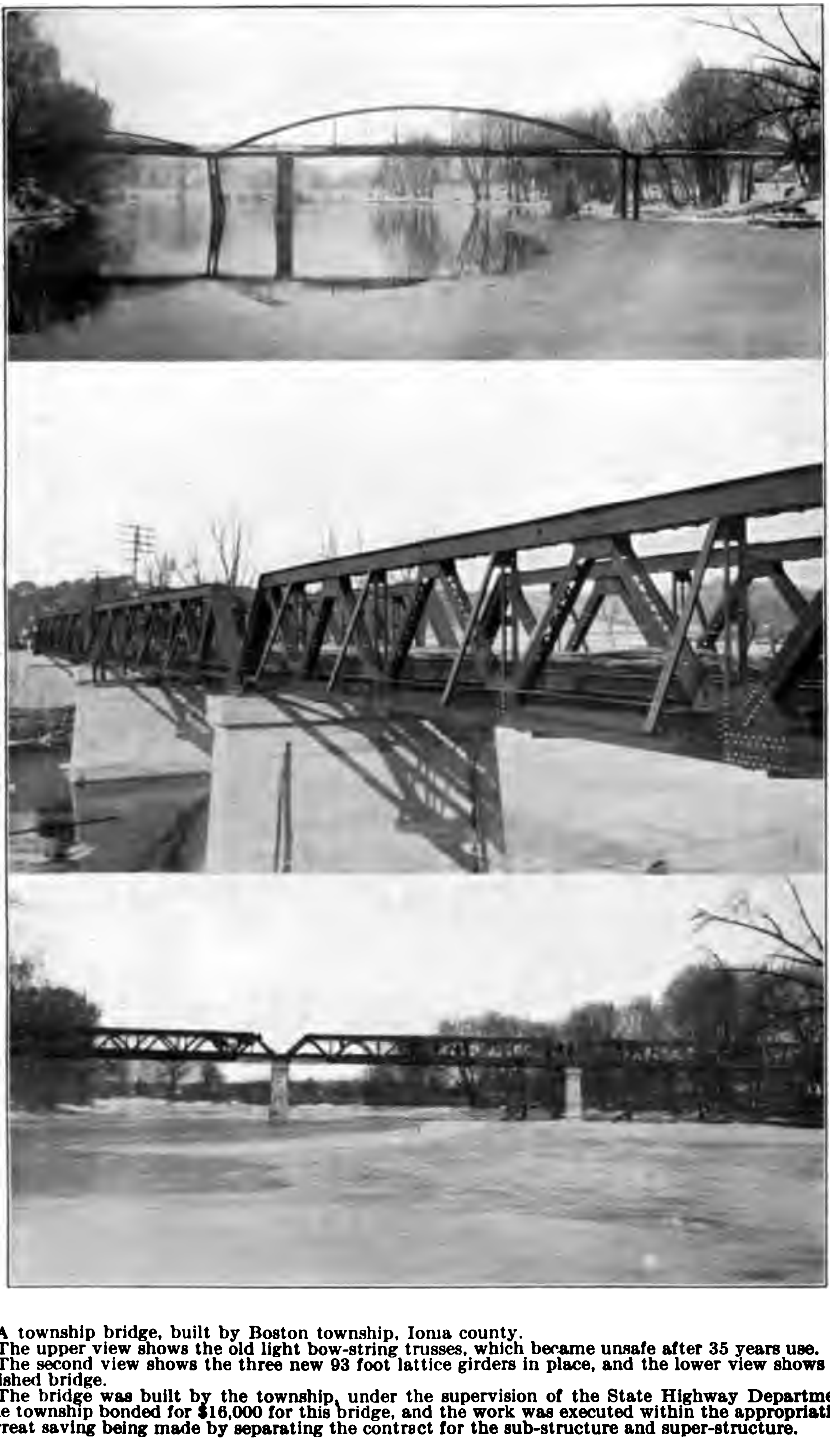
GENERAL SPECIFICATIONS FOR ROADS, CLASS C.

(STONE-GRAVEL OR SLAG.)

Section 10, Chapter V, Act No. 283, Public Acts 1909, as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

Grading.—The roadway shall be graded so as to strictly conform to the plans and specifications for the road in question, heretofore submitted to and approved by the State Highway Commissioner. The finished road shall be not less than twenty feet between and exclusive of



A township bridge, built by Boston township, Ionia county.

The upper view shows the old light bow-string trusses, which became unsafe after 35 years use.

The second view shows the three new 93 foot lattice girders in place, and the lower view shows the finished bridge.

The bridge was built by the township, under the supervision of the State Highway Department. The township bonded for $16,000 for this bridge, and the work was executed within the appropriation, a great saving being made by separating the contract for the sub-structure and super-structure.

side ditches or gutters and have a cross-section oval in form, with an average rise of one inch to the foot from the inner edge of such ditches or gutters to the center line of the road. Twenty feet is too narrow for the roadways of heavily traveled roads, and the State Highway Department recommends that turnpikes be made from twenty-two to twenty-four feet wide where the travel is heavy. In general, earth for fills should be taken from cuts. In no case shall deep, unsightly ditches be cut along the roadside for the purpose of making fills. For more details as to the manner of forming grades and ditches see cut on page 69.

Tile drains shall be laid where needed at such places, of such kind and size and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders described in the next paragraph, making outlets into the side ditches for water that may collect in the metal bed during construction and later before the surface becomes hard and water-proof. Such trenches shall be eight inches or more in width and slightly deeper than the metal bed. They shall be placed at all low points in the grade and not farther than one hundred feet apart in retentive soils, and must be filled with slag or stone when the first layer of metal is being applied.

Metal Bed and Shoulders.—After the road has been graded as above described the metal bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth or other suitable material shall be placed on each side of the metal bed not less than nine feet apart or such greater distance as may be required to retain the width of metal specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center, or, if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-Grade.—After the shoulders and metal bed have been formed as above described the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge and the roadway again rolled and left in solid and firm condition, everywhere parallel to the finished roadway, the metal bed being seven inches below the finished grade and having the same crown. In deep mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, rotten straw or fine brush shall be laid on sub-grade to prevent the first course of gravel from mixing with the sand.

Crushed Stone or Slag Course.—After the road has been graded and rolled in the manner above described, a layer of crushed stone or slag shall be spread on the prepared bed to such uniform thickness as to be not less than four inches deep after thorough rolling, five inches deep loose measure. The material for this course may be of a suitable grade of crushed slag, limestone, cobbles or trap rock, and shall consist only of that part of the crusher product passing over the three-fourths inch section and through the three-inch section of the crusher screen. This stone or slag shall be placed upon the road uniformly mixed, no patches of alternately large and small pieces being allowed. Unless automatic spreading wagons are used, this is usually best accomplished by making several dumps of each load, so that the least possible amount of handling with shovels and rakes will be required. In no case shall this course be laid on a muddy sub-grade.

Binder for Crushed Stone or Slag Course.—After the stone or slag has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to the uniform depth of from one-half to three-quarters of an inch with stone screenings or bank gravel and re-rolled. The amount of binder used shall be somewhat less than enough to fill the voids in the stone. Water may be applied in advance of the roller after the binder is added, if ordered by the officers in charge, but it should be used sparingly on clay sub-grades. The rolling must be continued till the binder is worked into the crevices of the larger stones and the stones cease to sink beneath the roller. If depressions are formed they shall be filled with stones of suitable grade, and not with screenings.

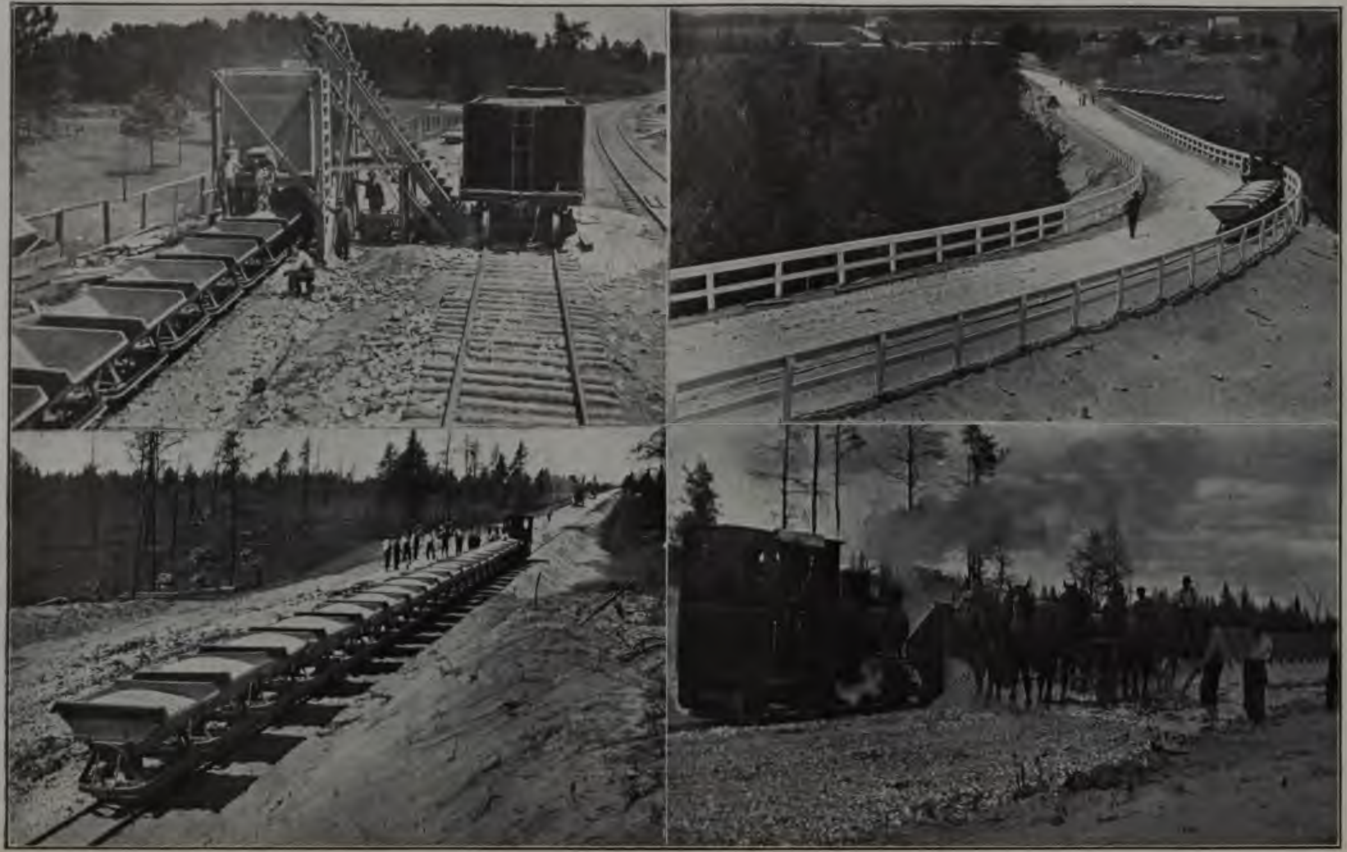
Stone screenings, which are preferable, used to bind this course may be that part of the crushed product passing through the three-fourths inch section of the crusher screen when crushing the stone used for this course. Gravel when used for binder shall be clean bank gravel of the kind hereinafter specified for the gravel top.

Gravel Top.—After the rolling above specified, the stone or slag course shall be covered with a layer of gravel of such thickness as will make a uniform depth of three inches after compacting, four inches loose measure. The gravel shall be clean bank gravel, sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of one and one-half inch mesh. If clay gravel is used it should contain only clay enough to coat the pebbles, no free lumps. In no case shall the clay exceed ten per cent of the mass, for clay makes mud and adds no wearing qualities.

This course shall be floated until the surface is smooth and even, then sprinkled and rolled until no further compacting is possible. Any hollows that may develop in the gravel top during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniform and hard, and everywhere conforms to the proposed grade and cross-section of the road.

Slag Top.—Only blast furnace slag will be allowed. The completed bottom course shall be covered with a layer of crushed slag of such thickness as will make a uniform depth of at least three inches after compacting, four inches loose measure. The slag bottom for this course shall consist only of that part of the crusher product passing over the one inch section and through the three inch section of the screen. This slag shall be placed upon the road uniformly mixed, no patches of alternately large and small slag being allowed. Unless automatic spreading wagons are used, this is best accomplished by making several dumps of each load so that the least possible amount of handling with shovels and rakes will be required.

Binder for the Slag Top.—After the slag has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to a uniform depth of about three-quarters of an inch with stone or slag screenings. The



Road under construction by Delta County Road Commission, Rapid River, Michigan.
Upper left-hand view shows stone being unloaded from car into dump cars. Upper right-hand view shows dinky engine pushing part of load up 5% grade.
Lower left-hand view shows twenty cars being hauled on a nearly level grade. Lower right-hand view shows stone being dumped and grader spreading the stone.

screenings may consist of that part of the crusher product passing over the one-quarter inch section and through the one inch section of the crusher screen when crushing slag for the slag top. Stone screenings are preferable. When limestone is used for the binder, the product shall consist of limestone chips ranging in size up to three-quarters inch from which the dust has been removed. The amount of screenings used must completely fill the voids in the larger slag. If depressions are formed, they shall be filled with the smaller slag of suitable grade and not with screenings. During the progress of the work the screenings will disappear in places, when more screenings must be added and rolling and sprinkling continued until the road has a uniformly hard and even surface and everywhere conforms to the proposed grade and cross-section of the road.

Rolling shall at all times begin at the sides of the road, rolling lengthwise, but working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch or gutter to gutter, and the whole road grade left in such condition that water will flow without obstruction to the side ditches.

The roller used shall weigh not less than ten tons.

GENERAL SPECIFICATIONS FOR ROADS—CLASS D.

(GRAVEL OR SLAG-STONE.)

Section 10, Chapter V, Act No. 283, Public Acts 1909, as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

This specification covers only water bound macadam top course. If a bituminous binder is to be used, a special specification must be furnished by, or approved by the State Highway Commissioner.

Grading.—The roadway shall be graded so as to strictly conform to the plans and specifications for the road in question, heretofore submitted to and approved by the State Highway Commissioner. The finished road shall not be less than twenty feet between and exclusive of side ditches or gutters and have a cross-section oval in form with an average rise of one inch to the foot from the inner edge of such ditch or gutter to the center line of the road. Twenty feet is too narrow for the roadways of heavily traveled roads and the State Highway Department recommends that turnpikes be made from twenty-two to twenty-four feet wide where the travel is heavy. In general, earth for fills should be taken from cuts. In no case shall deep, unsightly ditches be cut along the roadside for the purpose of making fills. For more details as to the manner of forming grades and ditches see cut on page 69.

Drainage.—The side ditches and gutters shall be of such size as the drainage requirements of the locality demand and must be formed with true grades, having sufficient incline to cause a free and uniform flow of water to the nearest natural outlets, which outlets must be so improved where necessary as to carry the water quickly away from the highway. The slopes of the banks of ditches shall be not steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed, at such places, of such kind and size and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders, described in the next paragraph, making outlets into the side ditches for water that may collect in the metal bed during construction and later before the surface becomes hard and water-proof. Such trenches shall be eight inches or more in width and slightly deeper than the gravel bed. They shall be placed at all low points in the grade and not farther than one hundred feet apart in retentive soils and must be filled with coarse gravel when the first layer of metal is being applied.

Metal Bed and Shoulders.—After the road has been graded as above described the metal bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth or other suitable material, will be placed on each side of the metal bed, not less than nine feet apart, or such greater distance as may be required to retain the width of metal specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center or if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-Grade.—After the shoulders and metal bed have been formed as above described, the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge and the roadway again rolled and left in solid and firm condition, everywhere parallel to the finished roadway, the metal bed being seven inches below the finished grade and having the same crown. In deep, mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, rotten straw or fine brush shall be laid on the sub-grade to prevent first course of gravel mixing with the sand.

Gravel Bottom.—After the road has been graded and rolled in the manner above described, a layer of gravel shall be spread on the prepared bed to such uniform thickness as to be not less than four inches deep after compacting, five inches loose measure.

The gravel for this course shall consist of good, clean bank gravel, not less than sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of two and one-half inch mesh. If clay gravel is used it should contain only clay enough to coat the pebbles, no free lumps. In no case shall the clay exceed ten per cent of the mass, for clay makes mud and adds no wearing qualities. The gravel course shall then be harrowed with a spike-tooth harrow and rolled until no further compacting is possible. The rolling must be done only when the road has been well wetted by sprinkling or after rains. Any hollows that may develop in this course of gravel during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniform and hard and everywhere parallel to and three inches below the surface of the finished road.

The crown can be preserved during construction by the occasional use of the grader or other suitable floating tools.

Ruts formed by hauling over the gravel shall be kept filled by using the harrow twice or more every day, preferably just before quitting time both noon and night.

Slag Bottom.—If slag is used, a layer of crushed slag of an approved quality shall be spread on the prepared bed to such uniform thickness as will make not less than four inches after thorough rolling, five inches deep loose measure. The slag shall consist only of that part of the crusher product passing over the one-inch section and through the three-inch section of the crusher screen. The slag shall be placed on the road uniformly mixed, no patches of alternately large and small pieces being allowed.

In no case shall the slag course be laid on a muddy sub-grade.

The slag course shall be bonded with gravel or stone screenings, no pieces of which shall be too large to pass through a one-inch screen. The amount of binder used shall be slightly less than enough to fill the voids in the slag. The sprinkling and rolling shall be the same as specified for the macadam top, except that water will be used sparingly on clay sub-grades and always under the direction of the officers in charge.

Macadam Top.—After the gravel or slag course has been applied and rolled as above specified, a layer of crushed stone shall be added, of such uniform thickness as to be not less than three inches deep after thorough rolling, four inches loose measure. The stone for this course may be a suitable grade of crushed limestone, cobbles or trap rock, and, in case of cobbles or trap rock, shall consist only of that part of the crusher product passing over the three-quarter inch section and through the two-inch section of the crusher screen, except for binder as hereinafter specified. When limestone is used for this course, it shall consist only of that part of the crusher product passing over the three-quarter inch section and through the three inch section of the screen. This stone shall be placed upon the road uniformly mixed, no patches of alternately large and small stones being allowed. Unless automatic spreading wagons are used, this is best accomplished by making several dumps of each load, so that the least possible amount of handling with shovels and rakes will be required.

Binding for Macadam Top.—After the stone has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to a uniform depth of about three-quarters of an inch with stone screenings. The screenings, when cobbles or trap rock, may consist of that part of the crusher product passing through the three-quarter inch section of the crusher screen when crushing stone for the macadam top. When limestone is used for the binder, the product shall consist of limestone chips ranging in size up to three-quarters inch from which the dust has been removed. The amount of screenings used must completely fill the voids in the larger stones. If depressions are formed they shall be filled with the smaller stones of suitable grade and not with screenings. During the progress of the work the screenings will disappear in places, when more screenings must be added and the rolling and sprinkling continued until the road has a uniformly hard and even surface and everywhere conforms to the proposed grade and cross-section of the road.

Rolling shall at all times begin at the sides of the road, rolling lengthwise, but working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch or gutter to gutter, and the whole road grade left in such condition that water will flow without obstruction to the side ditches.

The roller used shall weigh not less than ten tons.

GENERAL SPECIFICATIONS FOR ROADS—CLASS E.

Section 10, Chapter V, Act No. 283, Public Acts 1909, as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

This specification covers only water bound macadam. If bituminous binder is to be used, a special specification must be furnished by or approved by the State Highway Commissioner.

Grading.—The roadway shall be graded so as to strictly conform to the plans and specifications for the road in question, heretofore submitted to and approved by the State Highway Commissioner. The finished road shall be not less than twenty feet between and exclusive of side ditches or gutters, and have a cross-section oval in form with an average rise of one inch to the foot from the inner edge of such ditch or gutter to the center line of the road. Twenty feet is too narrow for the roadways of heavily traveled roads, and the State Highway Department recommends that turnpikes be made from twenty-two to twenty-four feet wide where the travel is heavy. For more details as to the manner of forming grades and ditches see cut on page 69.

Drainage.—The side ditches and gutters shall be of such size as the drainage requirements of the locality demand, and must be formed with true grades having sufficient incline to cause a free and uniform flow of water to the nearest natural outlets, which outlets must be so improved where necessary as to carry the water quickly away from the highway. The slopes of the banks of ditches shall be not steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed at such places, of such kind and size, and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders, one on each side, described in the next paragraph, making outlets into the side ditches for water that may collect in the macadam bed during construction and later before the surface becomes hard and water-proof. Such trenches shall be eight inches or more in width and slightly deeper than the macadam bed. They shall be placed at all low points in the grade, and not farther than one hundred feet apart in retentive soils, and must be filled with crushed stone when the first layer of macadam is being applied.

Macadam Bed and Shoulders.—After the road has been graded as above described the macadam bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth, or other suitable material, shall be placed on each side of the macadam bed, not less than nine feet apart, or such greater distance as may be required to retain the width of macadam specified. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high, the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center or, if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-Grade.—After the shoulders and macadam bed have been formed as above described the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge, and the roadway again rolled, and left in solid and firm condition, everywhere parallel to the finished roadway, the macadam bed being six inches below the finished grade and having the same crown. In deep mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, rotten straw or fine brush shall be laid on the sub-grade to prevent the first course from mixing with the sand.

First Course of Macadam.—To secure the product in sizes to comply with these specifications the crusher should be equipped with a revolving screen not less than nine feet long and thirty inches in diameter, having perforations as follows: First section, three-quarter inch holes; second section, two-inch holes; third section, three-inch holes. Any stones not small enough to pass through the three-inch holes shall be returned to the crusher and recrushed.

After the road has been graded and rolled in the manner above described, a layer of crushed stone shall be spread on the prepared bed to such uniform thickness as to be not less than three and one-half inches deep after thorough rolling, four and one-half inches deep loose measure. The stone for this course may be a suitable grade of crushed limestone, cobbles or trap rock, and shall consist only of that part of the crusher product passing over the three-quarter inch section and through the three inch section of the crusher screen. This stone shall be placed upon the road uniformly mixed, no patches of alternately large and small stones being allowed. Unless automatic spreading wagons are used, this is usually best accomplished by making several dumps of each load so that the least possible amount of handling with shovels and rakes will be required. In no case shall this course be laid on a muddy sub-grade.

Binder for First Course of Macadam.—After the stone has been spread as above described it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to the uniform depth of from one-half to three-quarters of an inch with stone screenings and re-rolled. The amount of binder used shall be somewhat less than enough to fill the voids in the stone. Water may be applied in advance of the roller after the binder is added, if ordered by the officers in charge, but it should be used sparingly on clay sub-grades. The rolling must be continued until the binder is worked into the crevices of the larger stones and the stones cease to sink or creep beneath the roller. If depressions are formed they shall be filled with stones of suitable grade, and not with screenings.

Stone screenings used to bind this course may be that part of the crusher product passing through the three-quarter inch section of the crusher screen when crushing the stone used for this course.

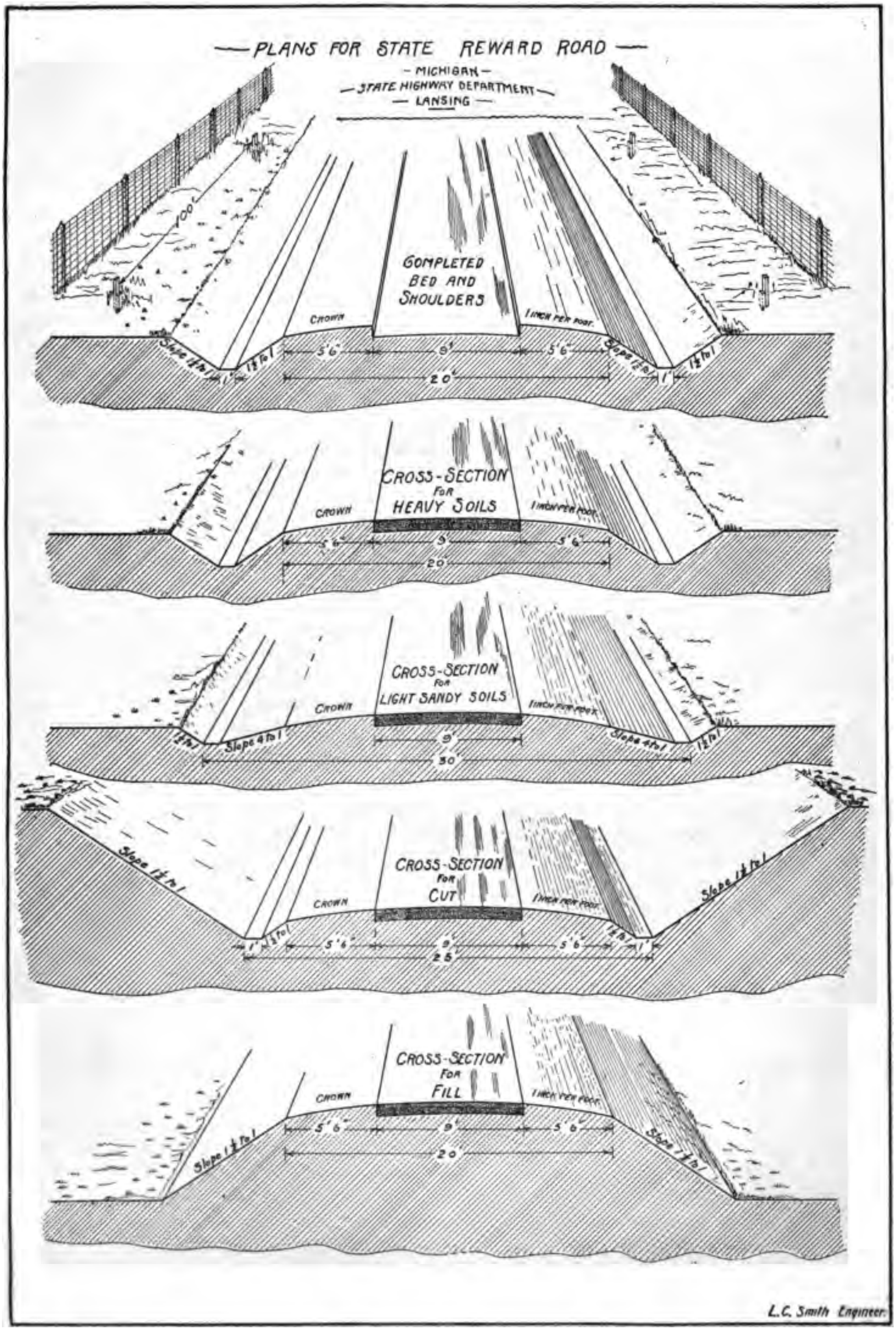
Top Course of Macadam.—After the first course of macadam has been applied, bonded and rolled as above specified, another layer of crushed stone shall be added, of such uniform thickness as to be not less than two and one-half inches deep after thorough rolling, three and one-half inches deep loose measure. The stone for this course may be a suitable grade of crushed limestone, cobbles or trap rock, and, in case of cobbles or trap rock, shall consist only of that part of the crusher product passing over the three-quarter inch section and through the two inch section of the crusher screen except for binder as hereinafter specified. When limestone is used for this course, it shall consist only of that part of the crusher product passing over the three-quarter inch section and through the three inch section of the screen. This stone shall be placed upon the road uniformly mixed, no patches of alternately large and small stones being allowed. Unless automatic spreading wagons are used, this is usually best accomplished by making several dumps of each load, so that the least possible amount of handling with shovels and rakes will be required.

Binder for Top Course of Macadam.—After the stone has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to a uniform depth of about three-quarters of an inch with stone screenings. The screenings, when cobble or trap rock, may consist of that part of the crusher product passing through the three-quarter inch section of the crusher screen when crushing stone for the macadam top. When limestone is used for the binder, the product shall consist of limestone chips, ranging in size from three-quarter inch down, from which the dust has been removed. The amount of screenings used must completely fill the voids in the larger stones. After the screenings are added, water shall be applied with a horse sprinkler and the road rolled and watered until it becomes so hard that a piece of rock will crush beneath the roller before penetrating the surface. If depressions are formed they shall be filled with the smaller stones of suitable grade and not with screenings. During the progress of the work the screenings will disappear in places, when more screenings must be added and the rolling and sprinkling continued until the road has a uniformly hard and even surface, and everywhere conforms to the proposed grade and cross-section of the road.

Applying Binder.—Screenings used for binder in both courses shall not be dumped in piles on the loose stones but rather dumped on the shoulders and carefully spread on the road by hand, care being taken that the screenings be placed on the road evenly mixed. This is best accomplished by casting lengthwise of the road rather than crosswise. Provided, however, that automatic spreading wagons may be used if an even spread can be obtained by their use.

Manner of Rolling.—Rolling shall at all times begin at the sides of the road, rolling lengthwise but working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch or gutter to gutter and the whole road grade left in such condition that water will flow without obstruction to the side ditches.

The roller used shall weigh not less than ten tons.


PLANS FOR STATE REWARD ROAD
MICHIGAN
STATE HIGHWAY DEPARTMENT
LANSING
100'
COMPLETED BED AND SHOULDERS
CROWN
1 INCH PER FOOT.
Slope 1½ to 1
1½ to 1
1'
5'6"
9'
20'
CROSS-SECTION FOR HEAVY SOILS
CROSS-SECTION FOR LIGHT SANDY SOILS
Slope 4 to 1
30'
CROSS-SECTION FOR CUT
25'
CROSS-SECTION FOR FILL
L. C. Smith Engineer.

SPECIFICATIONS FOR TRUNK LINE ROADS—CLASS B. (GRAVEL.)

Act 334, Public Acts 1913 and Act No. 283, Public Acts 1909 as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

Grading.—The roadway shall be graded so as to strictly conform to the plans and profiles for the road in question, heretofore prepared by and approved by the State Highway Commissioner. The finished road shall be not less than twenty-four feet between and exclusive of side ditches or gutters and have a cross-section oval (parabolic) in form, with an average rise of three-fourths inch to the foot from the inner edge of such ditch or gutter to the center line of the road. In general, earth for fills should be taken from cuts. In no case shall deep unsightly ditches be cut along the roadside for the purpose of making fills. For more details as to the manner of forming grades and ditches see plans and profiles, also cross-sections on page 75.

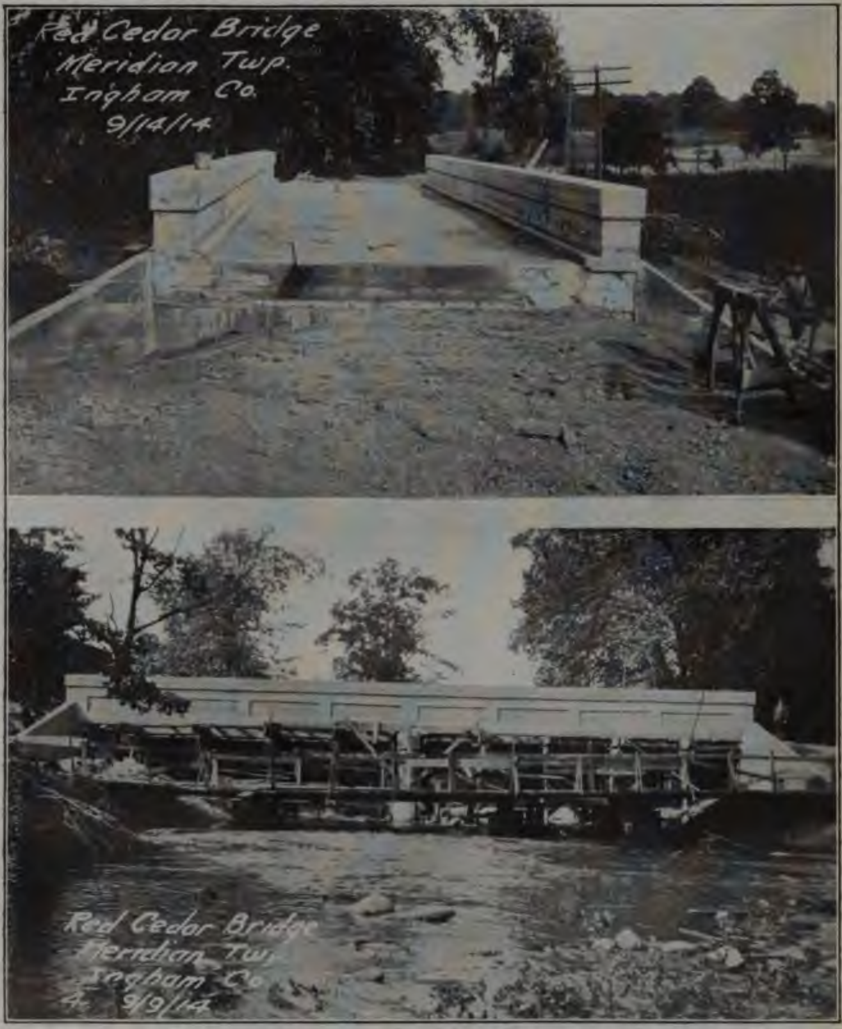
Drainage.—The side ditches and gutters shall be of such size as the drainage requirements of the locality demand and must be formed with true grades, having sufficient incline to furnish a free and uniform flow of water to the nearest natural outlets, which outlets must be so improved, where necessary, as to carry the water quickly away from the highway. The slope of the banks of ditches shall be not steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed at such places and of such kind and size and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders described in the next paragraph, making outlets into the side ditches for water that may collect in the gravel bed during construction and later before the surface becomes hard and water proof. Such trenches shall be eight inches or more in width and slightly deeper than the gravel bed. They shall be placed at all low points in the grade and not farther than one hundred feet apart in retentive soils and filled with coarse gravel when the first layer of gravel is being applied.

Gravel Bed and Shoulders.—After the road has been graded as above described the gravel bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth or other suitable material shall be placed on each side of the gravel bed such distance as may be required by the plans. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center, or, if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-Grade.—After the shoulders and gravel bed have been



Red Cedar Trunk Line Bridge, Meridian Township, Ingham County.
Two 40 foot reinforced concrete girders, built by the State Highway Department.
Absolutely permanent. All steel is embedded in concrete.
For contract price and other details, see Trunk Line Bridge Table on page 100.

formed as above described the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge and the roadway again rolled and left in solid and firm condition everywhere parallel to the finished roadway, the metal bed being eight inches below the finished grade and having the same crown. In deep mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, wet straw or fine brush shall be laid on sub-grade to prevent the first course of gravel from mixing with the sand.

First Course of Gravel.—After the road has been graded and rolled in the manner above described, a layer of gravel shall be spread on the prepared bed to such uniform thickness as to be not less than five inches deep after compacting, six inches deep, loose measure. The gravel for this course shall consist of good, clean bank gravel, not less than sixty per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of two and one-half inch mesh. If clay gravel is used, it should contain only clay enough to coat the pebbles, no free lumps. In no case should the clay exceed ten per cent of the mass, for clay makes mud and adds no wearing qualities. The gravel course shall then be harrowed with a spike tooth harrow and rolled until no further compacting is possible. The rolling must be done only when the road has been well wetted by sprinkling or after rains. Any hollows that may develop in the gravel during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniformly smooth and hard and everywhere parallel to and three inches below the surface of the finished road. The crown can be preserved during construction by the occasional use of the grader or other suitable floating tools. Ruts formed by hauling over the gravel shall be kept filled by using the harrow twice or more every day, preferably just before quitting time both noon and night.

Second Course of Gravel.—The gravel for the second course shall consist of good, clean bank gravel, seventy-five per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and will pass through a screen of one and one-half inch mesh. Other requirements for gravel in this course are the same as specified for gravel in the first course. This gravel shall be spread on the road to such uniform thickness as to be not less than three inches deep after compacting, four inchess loose measure, after which it shall be harrowed and rolled in the same manner as prescribed for the first course. Any depressions that may be formed during the rolling shall be filled with the kind of gravel prescribed for the second course and the road re-rolled until the surface is uniformly smooth and hard and everywhere conforms to the proposed grade and cross-section of the road.

Manner of Rolling.—Rolling shall be done only when the gravel has been thoroughly wetted by sprinkling or recent rains, and shall at all times begin at the sides, rolling lengthwise of the road, but gradually working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch and the whole road grade left in such perfect condition that water will flow without obstruction to the side ditches. Rolling may be done with a power roller, a heavy horse roller or a traction engine followed by a weighted field roller, if one of suitable strength to bear weighting to three or more tons can be obtained.

With any kind of a roller the spike-tooth harrow, preferably of the lever type, should be used as long as the teeth will penetrate the surface.

SPECIFICATIONS FOR TRUNK LINE ROADS—CLASS C.

(STONE-GRAVEL.)

Act 334, Public Acts 1913 and Act No. 283, Public Acts 1909, as amended.

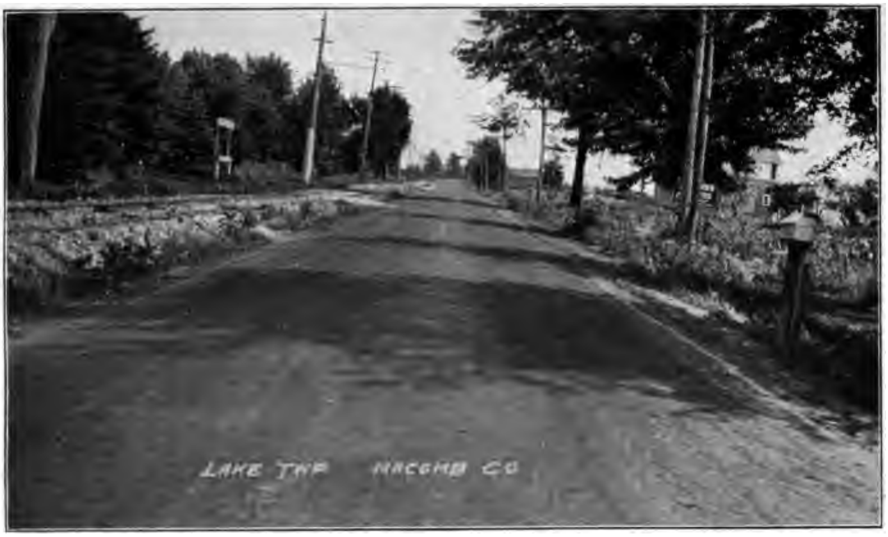
If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

Grading.—The roadway shall be graded so as to strictly conform to the plans and profiles for the road in question, heretofore prepared by and approved by the State Highway Commissioner. The finished road shall be not less than twenty-four feet between and exclusive of side ditches or gutters and have a cross-section oval (parabolic) in form, with an average rise of three-fourths inch to the foot from the inner edge of such ditches or gutters to the center line of the road. In general, earth for fills should be taken from cuts. In no case shall deep, unsightly ditches be cut along the roadside for the purpose of making fills. For more details as to the manner of forming grades and ditches see plans and profiles and cross-sections, page 75.

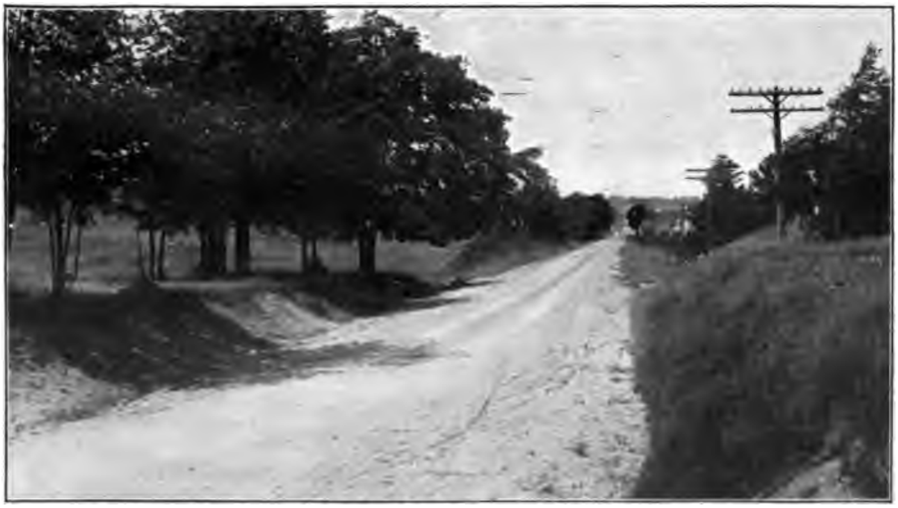
Tile drains shall be laid where needed at such places, of such kind and size and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders described in the next paragraph, making outlets into the side ditches for water that may collect in the metal bed during construction and later before the surface becomes hard and water-proof. Such trenches shall be eight inches or more in width and slightly deeper than the metal bed. They shall be placed at all low points in the grade and not farther than one hundred feet apart in retentive soils, and must be filled with slag or stone when the first layer of metal is being applied.

Metal Bed and Shoulders.—After the road has been graded as above described the metal bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth or other suitable material shall be placed on each side of the metal bed such distance as may be required by the plans. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center, or, if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.



Lake township, Macomb county, sixteen foot macadam road constructed by the Board of County Road Commissioners. This road lies directly north and east of Grosse Pointe Farms, Wayne county, and receives a heavy automobile traffic.



County Road in Grand Traverse county, on the trunk line. Fourteen foot gravel road. Note the sodded side slopes. Built by County Road Commissioners.

Rolling Sub-Grade.—After the shoulders and metal bed have been formed as above described the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge and the roadway again rolled and left in solid and firm condition, everywhere parallel to the finished roadway, the metal bed being seven inches below the finished grade and having the same crown. In deep mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, wet straw or fine brush shall be laid on sub-grade to prevent the first course of gravel frrom mixing with the sand.

Crushed Stone or Slag Course.—After the road has been graded and rolled in the manner above described, a layer of crushed stone or slag shall be spread on the prepared bed to such uniform thickness as to be not less than four inches deep after thorough rolling, five inches deep loose measure. The material for this course may be of a suitable grade of crushed slag, limestone, cobbles or trap rock, and shall consist only of that part of the crusher product passing over the three-fourths inch section and through the three-inch section of the crusher screen. This stone or slag shall be placed upon the road uniformly mixed, no patches of alternately large and small pieces being allowed. Unless automatic spreading wagons are used, this is usually best accomplished by making several dumps of each load, so that the least possible amount of handling with shovels and rakes will be required. In no case shall this course be laid on a muddy sub-grade.

Binder for Crushed Stone or Slag Course.—After the stone or slag has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to the uniform depth of from one-half to three-quarters of an inch with stone screenings or bank gravel and re-rolled. The amount of binder used shall be somewhat less than enough to fill the voids in the stone. Water may be applied in advance of the roller after the binder is added, if ordered by the officers in charge, but it should be used sparingly on clay sub-grades. The rolling must be continued till the binder is worked into the crevices of the larger stones and the stones cease to sink or creep beneath the roller. If depressions are formed they shall be filled with stones of suitable grade, and not with screenings.

Stone screenings, which are preferable, used to bind this course may be that part of the crusher product passing through the three-fourths inch section of the crusher screen when crushing the stone used for this course. Gravel when used for binder shall be clean bank gravel of the kind hereinafter specified for the gravel top.

EITHER SLAG OR GRAVEL TOP.

Slag Top.—Only blast furnace slag will be allowed. The completed bottom course shall be covered with a layer of crushed slag of such thickness as will make a uniform depth of at least three inches after compacting, four inches loose measure. The slag bottom for this course shall consist only of that part of the crusher product passing over the one inch section and through the three inch section of the screen. This slag shall be placed upon the road uniformly mixed, no patches of alternately large and small slag being allowed. Unless automatic spreading wagons are used, this is best accomplished by making several dumps of each load so that the least possible amount of handling with shovels and rakes will be required.

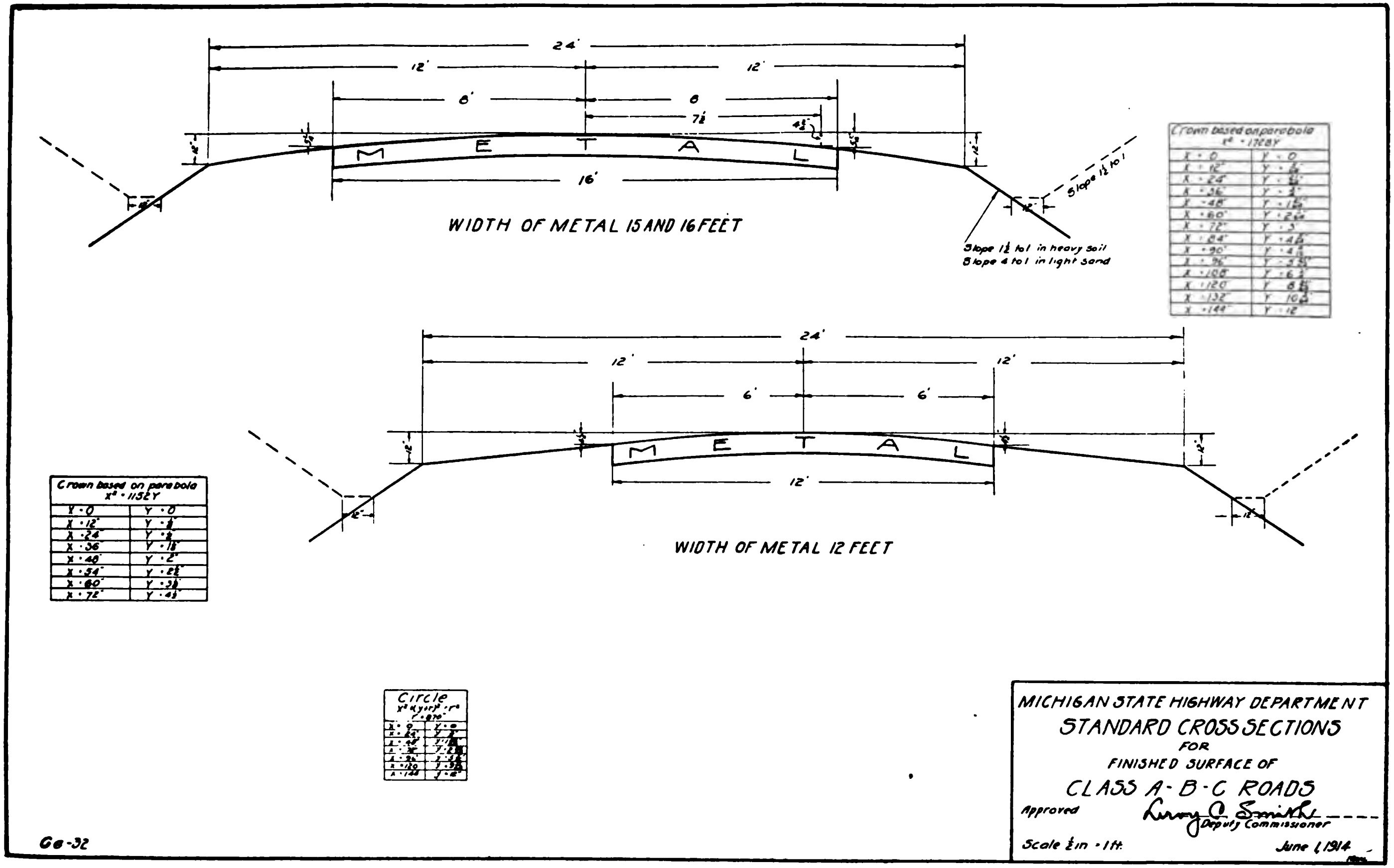
Binder for the Slag Top.—After the slag has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to a uniform depth of about three-quarters of an inch with stone or slag screenings. The screenings may consist of that part of the crusher product passing over the one-quarter inch section and through the one inch section of the crusher screen when crushing slag for the slag top. Stone screening are preferable. When limestone is used for binder, the product shall consist of limestone chips ranging in size up to three-quarters inch from which the dust has been removed. The amount of screenings used must completely fill the voids in the large slag. If depressions are formed they shall be filled with the smaller slag of suitable grade and not with screenings. During the progress of the work the screenings will disappear in places, when more screenings must be added and the rolling and sprinkling continued until the road has a uniformly hard and even surface and everywhere conforms to the proposed grade and cross-section of the road.

Gravel Top.—After the rolling above specified, the stone or slag course shall be covered with a layer of gravel of such thickness as will make a uniform depth of three inches after compacting, four inches loose measure. The gravel shall be clean bank gravel, seventy-five per cent by weight, a larger per cent if possible, of which shall be pebbles that will be retained on a screen of one-eighth inch mesh and pass through a screen of one and one-half inch mesh. If clay gravel is used it should contain only clay enough to coat the pebbles, no free lumps. In no case shall the clay exceed ten per cent of the mass, for clay makes mud and adds no wearing qualities.

This course shall be floated until the surface is smooth and even, then sprinkled and rolled until no further compacting is possible. Any hollows that may develop in the gravel top during the process of rolling shall be filled with the same kind of gravel and the rolling continued until the surface is uniform and hard, and everywhere conforms to the proposed grade and cross-section of the road.

Manner of Rolling.—Rolling shall at all times begin at the sides of the road, rolling lengthwise and gradually working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch or gutter to gutter and the whole road grade left in such condition that water will flow without obstruction to the side ditches.

The roller used shall weigh not less than ten tons.


24'
12'
12'
8'
8
7½
4½
16'
M E T A L
Slope 1½ to 1
Slope 1½ to 1 in heavy soil
Slope 4 to 1 in light sand
WIDTH OF METAL 15 AND 16 FEET
Crown based on parabola
X² = 1728Y
X = 0 Y = 0
X = 12"
X = 24"
X = 36"
X = 48"
X = 60"
X = 72" Y = 3"
X = 84"
X = 90"
X = 96"
X = 108"
X = 120"
X = 132"
X = 144" Y = 12
24'
12'
12'
6'
6'
12'
M E T A L
WIDTH OF METAL 12 FEET
Crown based on parabola
X² = 1152Y
X = 0 Y = 0
X = 12"
X = 24
X = 36
X = 48" Y = 2"
X = 54"
X = 60"
X = 72"
Circle
X = 120
X = 144
MICHIGAN STATE HIGHWAY DEPARTMENT
STANDARD CROSS SECTIONS
FOR
FINISHED SURFACE OF
CLASS A-B-C ROADS
Approved Leroy C. Smith Deputy Commissioner
Scale ½ in = 1 ft.
June 1, 1914
Ge-32

SPECIFICATIONS FOR TRUNK LINE ROADS—CLASS E.

(MACADAM.)

Act No. 334 Public Acts 1913 and Act 283 Public Acts 1909 as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

This specification covers only water bound macadam. If bituminous binder is to be used, a special specification must be furnished by or approved by the State Highway Commissioner.

Grading.—The roadway shall be graded so as to strictly conform to the plans and profiles for the road in question, herewith furnished and approved by the State Highway Commissioner. The finished road shall be not less than twenty-four feet between and exclusive of side ditches or gutters, and have a cross-section oval (parabolic) in form with an average rise of three-fourths inch to the foot from the inner edge of such ditch or gutter to the center line of the road. For more details as to the manner of forming grades and ditches see plans and profiles.

Drainage.—The side ditches and gutters shall be of such size as the drainage requirements of the locality demand, and must be formed with true grades having sufficient incline to cause a free and uniform flow of water to the nearest natural outlets, which outlets must be so improved where necessary as to carry the water quickly away from the highway. The slopes of the banks of ditches shall be not steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed at such places, of such kind and size, and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders, one on each side, described in the next paragraph, making outlets into the side ditches for water that may collect in the macadam bed during construction and later before the surface becomes hard and water-proof. Such trenches shall be eight inches or more in width and slightly deeper than the macadam bed. They shall be placed at all low points in the grade, and not farther than one hundred feet apart in retentive soils, and must be filled with crushed stone when the first layer of macadam is being applied.

Macadam Bed and Shoulders.—After the the road has been graded as above described the macadam bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth, or other suitable material, shall be placed on each side of the macadam bed, such distance as may be required by the plans. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high, the shoulders may be formed by moving earth from the center of the present road grade to the sides or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center or, if sufficient suitable

Where the West Michigan Pike branches north of Manistee.
To the left; Frankfort, Glen Haven to Traverse City.
To the right; Beulah, Honor to Traverse City.
Both roads have 15 foot gravel track. At this point they were built by Manistee County Road Commission.

material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-Grade.—After the shoulders and macadam bed have been formed as above described the whole roadway shall be rolled until no more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the officers in charge, and the roadway again rolled, and left in solid and firm condition, everywhere parallel to the finished roadway, the macadam bed being six inches below the finished grade and having the same crown. In deep mealy sand, where rolling is impracticable when sub-grade is shaped, marsh hay, wet straw or fine brush shall be laid on the sub-grade to prevent the first course from mixing with the sand.

First Course of Macadam.—To secure the product in sizes to comply with these specifications the crusher should be equipped with a revolving screen not less than nine feet long and thirty inches in diameter, having perforations as follows: First section, three-quarter inch holes; second section, two-inch holes; third section, three-inch holes. Any stones not small enough to pass through the three inch holes shall be returned to the crusher and recrushed.

After the road has been graded and rolled in the manner above described, a layer of crushed stone shall be spread on the prepared bed to such uniform thickness as to be not less than three and one-half inches deep after thorough rolling, four and one-half inches deep loose measure. The stone for this course may be a suitable grade of crushed limestone, cobbles or trap rock, and shall consist only of that part of the crusher product passing over the three-quarter inch section and through the three inch section of the crusher screen. This stone shall be placed upon the road uniformly mixed, no patches of alternately large and small stones being allowed. Unless automatic spreading wagons are used, this is usually best accomplished by making several dumps of each load so that the least possible amount of handling with shovels and rakes will be required. In no case shall this course be laid on a muddy sub-grade.

Binder for First Course of Macadam.—After the stone has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to the uniform depth of from one-half to three-quarters of an inch with stone screenings and re-rolled. The amount of binder used shall be somewhat less than enough to fill the voids in the stone. Water may be applied in advance of the roller after the binder is added, if ordered by the officers in charge, but it should be used sparingly on clay sub-grades. The rolling must be continued until the binder is worked into the crevices of the larger stones and the stones cease to sink or creep beneath the roller. If depressions are formed they shall be filled with stones of suitable grade, and not with screenings.

Stone screenings used to bind this course may be that part of the crusher product passing through the three-quarter inch section of the crusher screen when crushing the stone used for this course.

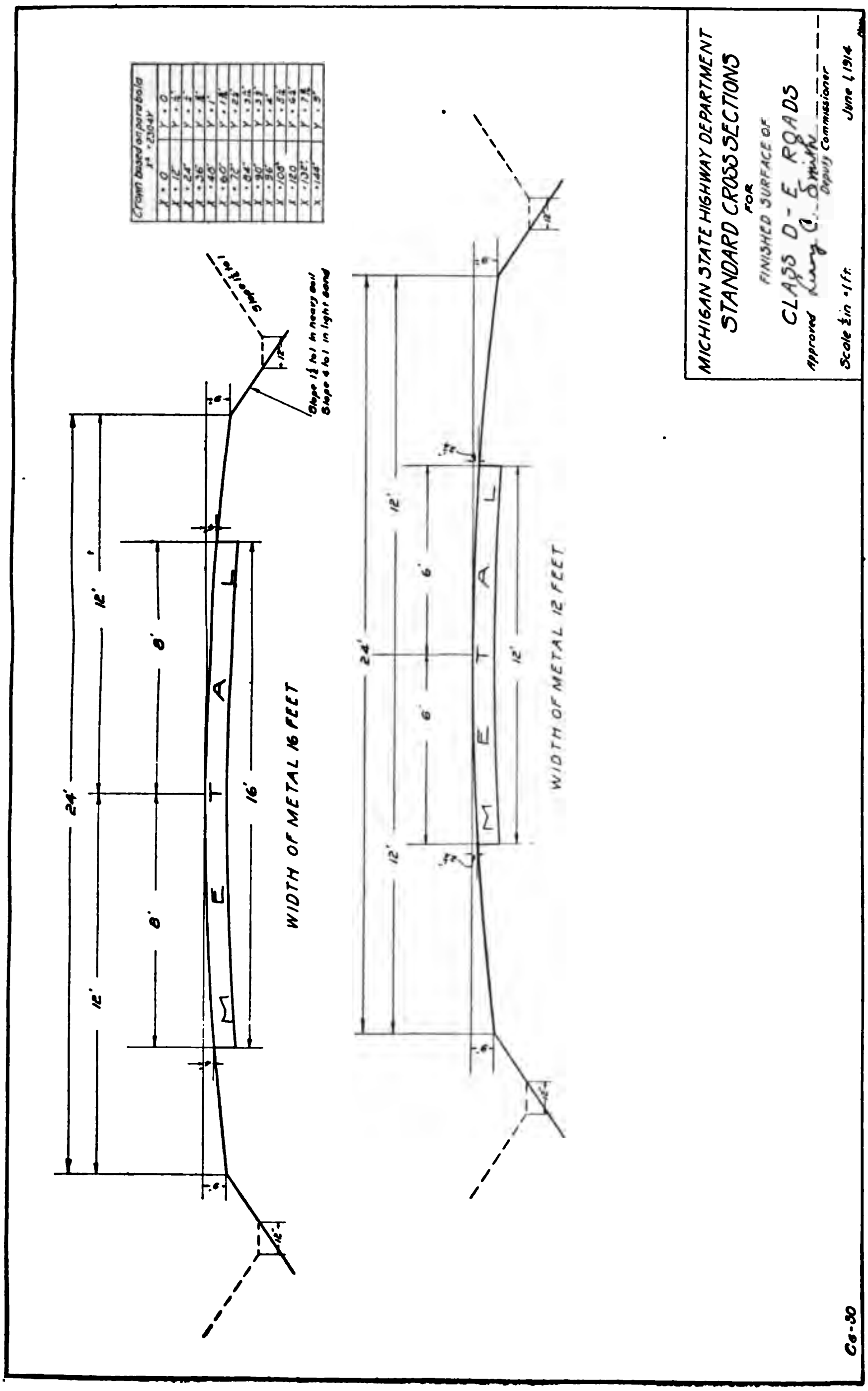
Top Course of Macadam.—After the first course of macadam has been applied, bonded and rolled as above specified, another layer of crushed stone shall be added, of such uniform thickness as to be not less than two and one-half inches deep after thorough rolling, three and one-half inches deep loose measure. The stone for this course may be a suitable grade of crushed limestone, cobbles or trap rock, and, in case of cobbles or trap rock, shall consist only of that part of the crusher product passing over the three-quarter inch section and through the two inch section of the crusher screen except for binder as hereinafter specified. When limestone is used for this course, it shall consist only of that part of the crusher product passing over the three-quarter inch section and through the three inch section of the screen. This stone shall be placed upon the road uniformly mixed, no patches of alternately large and small stones being allowed. Unless automatic spreading wagons are used, this is usually best accomplished by making several dumps of each load, so that the least possible amount of handling with shovels and rakes will be required.

Binder for Top Course of Macadam.—After the stone has been spread as above described, it shall be rolled two or three times over with a roller weighing not less than ten tons, after which it shall be covered to a uniform depth of about three-quarters of an inch with stone screenings. The screenings, when cobble or trap rock, may consist of that part of the crusher product passing through the three-quarter inch section of the crusher screen when crushing stone for the macadam top. When limestone is used for the binder, the product shall consist of limestone chips, ranging in size from three-quarter inch down, from which the dust has been removed. The amount of screenings used must completely fill the voids in the larger stones. After the screenings are added, water shall be applied with a horse sprinkler and the road rolled and watered until it becomes so hard that a piece of rock will crush beneath the roller before penetrating the surface. If depressions are formed they shall be filled with the smaller stones of suitable grade and not with screenings. During the progress of the work the screenings will disappear in places, when more screenings must be added and the rolling and sprinkling continued until the road has a uniformly hard and even surface, and everywhere conforms to the proposed grade and cross-section of the road.

Applying Binder.—Screenings used for binder in both courses shall not be dumped in piles on the loose stones but rather dumped on the shoulders and carefully spread on the road by hand, care being taken that the screenings be placed on the road evenly mixed. This is best accomplished by casting lengthwise of the road rather than crosswise. Provided, however, that automatic spreading wagons may be used if an even spread can be obtained by their use.

Manner of Rolling.—Rolling shall at all times begin at the sides of the road, rolling lengthwise but working toward the center. In the final rolling the whole surface of the roadway, including the shoulders, shall be rolled from ditch to ditch or gutter to gutter and the whole road grade left in such condition that water will flow without obstruction to the side ditches.

The roller used shall weigh not less than ten tons.


MICHIGAN STATE HIGHWAY DEPARTMENT
STANDARD CROSS SECTIONS
FOR
FINISHED SURFACE OF
CLASS D-E ROADS
Approved
Deputy Commissioner
Scale ¼ in = 1 ft.
June 1, 1914
Crown based on parabola
X = 0
X = 12
X = 24
X = 36
X = 48
X = 60
X = 72
X = 84
X = 96
X = 108
X = 120
X = 132
X = 144
Y = 0
Slope 1½ to 1 in heavy soil
Slope 4 to 1 in light sand
12"
6"
24'
12'
12'
8'
8'
16'
METAL
WIDTH OF METAL 16 FEET
24'
12'
12'
6'
6'
12'
METAL
WIDTH OF METAL 12 FEET
Cs-30

SPECIFICATIONS FOR TRUNK LINE ROADS—CLASS F.

(CEMENT—CONCRETE.)

Act No. 334, Public Acts 1913, and Act 283, Public Acts 1909, as amended.

If the work is to be done by contract, write the State Highway Department for blank forms for bids, contracts and bonds. They will be furnished without charge.

Grading.—The roadway shall be graded so as to strictly conform to the plans and profiles for the road in question, herewith furnished and approved by the State Highway Commissioner. The finished road shall be not less than twenty-four feet between and exclusive of side ditches or gutters, and have a cross-section oval (parabolic) in form with an average rise of one-fourth inch to the foot in the concrete roadway and one and one-fourth inches per foot in the shoulders. For more details as to the manner of forming grades and ditches see plans and profiles.

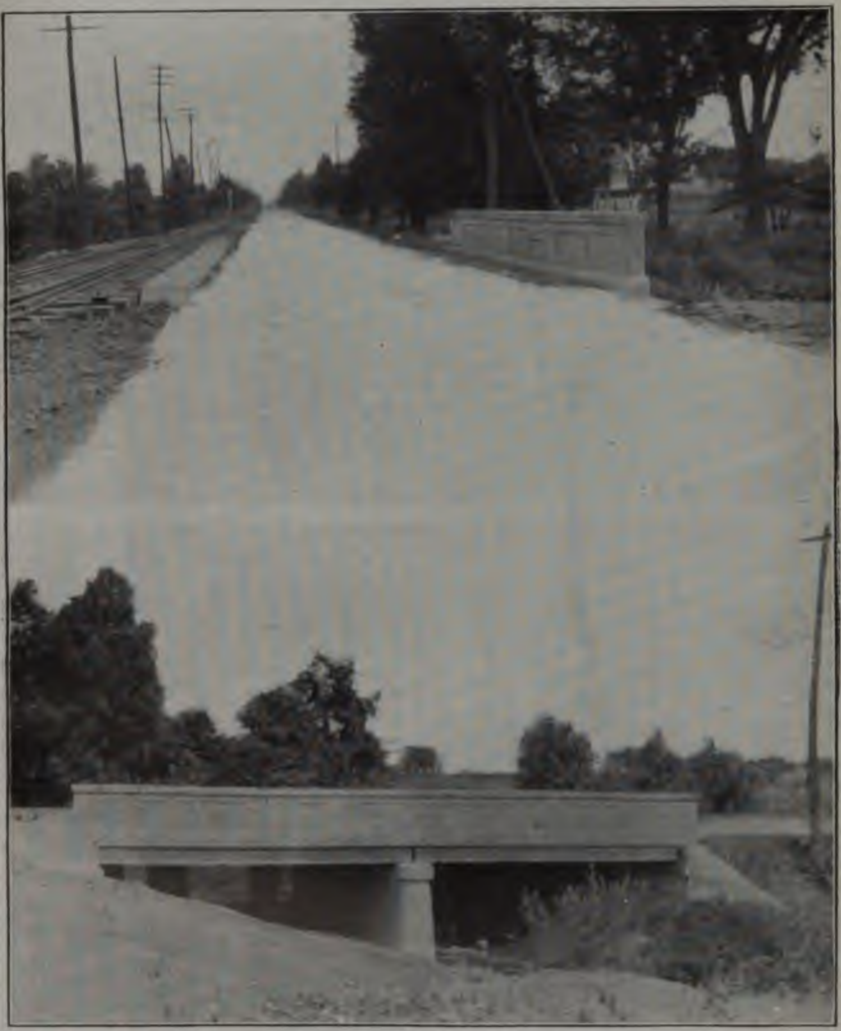
Drainage.—The side ditches and gutters shall be of such size as the drainage requirements of the locality demand, and must be formed with true grades having sufficient incline to cause a free and uniform flow of water to the nearest natural outlets, which outlets must be so improved where necessary as to carry the water quickly away from the highway. The slopes of the banks of ditches shall be not steeper than one and one-half horizontal to one vertical.

Tile drains shall be laid where needed at such places, of such kind and size, and on such grades as may be shown on the plans.

In clay soils trenches shall be cut through the shoulders, one on each side, described in the next paragraph, making outlets into the side ditches for water that may collect under the concrete. Such trenches shall be eight inches or more in width and slightly deeper than the concrete bed. They shall be placed at all low points in the grade, and not farther than one hundred feet apart in retentive soils, and must be filled with crushed stone or coarse gravel.

Concrete Bed and Shoulders.—After the road has been graded as above described, the concrete bed shall be formed in the central part of the road grade as follows: Shoulders of firm earth, or other suitable material, shall be placed on each side of the concrete bed, such distance as may be required by the plans. The shoulders shall extend to the side ditches or gutters at the same grade and curvature as required for the finished road. Where the road grade is high, the shoulders may be formed by moving earth from the center of the present road grade to the sides, or, if the grade is low, by crowning the present road grade by scraping earth from the sides toward the center, or, if sufficient suitable material cannot be had along the roadway, it shall be brought from other places along the line of work.

Rolling Sub-Grade.—After the shoulders and concrete bed have been formed as above described, the whole roadway shall be rolled until no



State Trunk Line Bridge on Michigan Avenue, crossing Shovin Creek, Wayne County, built by the State Highway Department.

Steel I-beam floor system with reinforced concrete floor and guard rail.

The concrete floor forms a part of Wayne County's concrete road. For contract price and other details, see Trunk Line Bridge Table Number 2, page 100.

more compacting is possible. The hollows developed by this rolling shall be filled with suitable material under the direction of the engineer or officers in charge, and the roadway again rolled, and left in solid and firm condition, everywhere parallel to the finished roadway, the concrete bed being six inches below the finished grade and having the same crown.

Forms.—After the preparation of the sub-base, forms consisting of 2in. x 6in. dressed plank shall be placed on each side of the roadway, at the specified distance from the center line and such distance below the center line grade, as is shown by the plans and profiles of the road. The planks shall be securely staked so that they will hold their true line and grade while the concrete is being placed and while it is hardening.

Concrete Roadway.—Upon the sub-base prepared as hereinbefore specified, shall be laid a one course concrete pavement, not less than six inches thick, mixed in the following proportions, viz:

American Portland cement.........	1 part.
Clean sharp sand..................	2 parts.
Broken stone, or gravel............	3½ parts.

Cement.—Only such Portland cement shall be used as conforms to the Standard Specifications for Portland Cement adopted by the American Society for Testing Materials, August 16th, 1909, with the subsequent amendments.

The Contractor must notify the officers in charge and the State Highway Commissioner ten days in advance of the laying of concrete, of the brand of cement he proposes to use, and when it has been examined and approved, that brand or one of equal quality, which must also be approved by the State Highway Commissioner, shall be used throughout the work.

A sack of cement (94 pounds net) shall be considered to have a volume of one cubic foot.

The State Highway Commissioner may require that the cement be tested, and each shipment certified to by a reputable testing laboratory.

All cement delivered on the work shall be thoroughly protected from the elements.

Fine Aggregate.—The fine aggregate shall consist of sand, free from clay, loam, vegetable matter and dust, well graded from fine to coarse, all of which shall pass, when dry, a screen of one-quarter inch mesh, and so graded that the voids, as determined by saturation, shall not exceed 33 per cent.

Coarse Aggregate.—The coarse aggregate shall consist of clean, hard, durable, crushed stone, or screened, washed gravel, graded in size from material retained on a screen having one-fourth inch mesh and passing through a screen having a two and one-half inch mesh.

Water.—Water shall be clean, free from oil, acid, alkali or vegetable matter.

Measuring and Proportioning.—All material shall be measured in suitable boxes, or in wheelbarrows, of a measured capacity. Each wheelbarrow load shall be surface struck with a template.

Mixing.—The ingredients of the concrete shall be mixed to the desired consistency in a batch concrete mixer of an approved type, and mixing shall continue until the cement is uniformly distributed and the concrete is homogeneous and uniform in color. The concrete shall be mixed with water above specified, wet enough to produce a concrete that will flush readily under light tamping, but the amount of water used shall not be sufficient to cause a separation of the coarse aggregate from the mortar in handling the concrete.

Retempering or re-mixing concrete that is partially hardened will not be permitted.

Depositing Concrete.—The concrete, prepared as above specified, shall be deposited in strips extending across the full width of the roadway, and shall be deposited as soon after mixing as practicable, and in no case shall more than fifteen minutes elapse between the mixing and depositing of the concrete.

Concrete shall be laid and finished from one transverse expansion joint to another, in one continuous operation, and the stoppage of concrete laying for more than thirty minutes, must be at an expansion joint, and the surface finished to that point.

The sub-base must be kept moist while the concrete is being deposited.

Concrete shall not be laid when the temperature at any time during the day or the night falls below 35° above zero Fahrenheit.

Expansion Joints.—Vertical transverse expansion joints shall be placed across the concrete roadway perpendicular to the center line, not more than thirty feet apart, extending entirely through the concrete. These joints may consist of heavy three-ply tar paper carefully placed, or may be formed with a ½in. dressed board which has been tapered to "draw" and has been shaped so that its edge will fit the specified crown of the roadway. When the concrete has set, this board shall be removed carefully, the rough edges of the concrete smoothed off and the joints filled with an approved paving pitch, which is not soft enough to "bleed" in hot weather nor brittle enough to chip in cold weather. After filling, the joints shall be lightly covered with coarse sand.

Finishing.—After the concrete has been brought to the required grade by means of a suitable template the surface shall be worked with a wood float, in such a manner as to thoroughly compact it and to produce a smooth uniform surface. Before the concrete surface becomes hardened, it shall be slightly roughened by brushing with a stiff fibre broom.

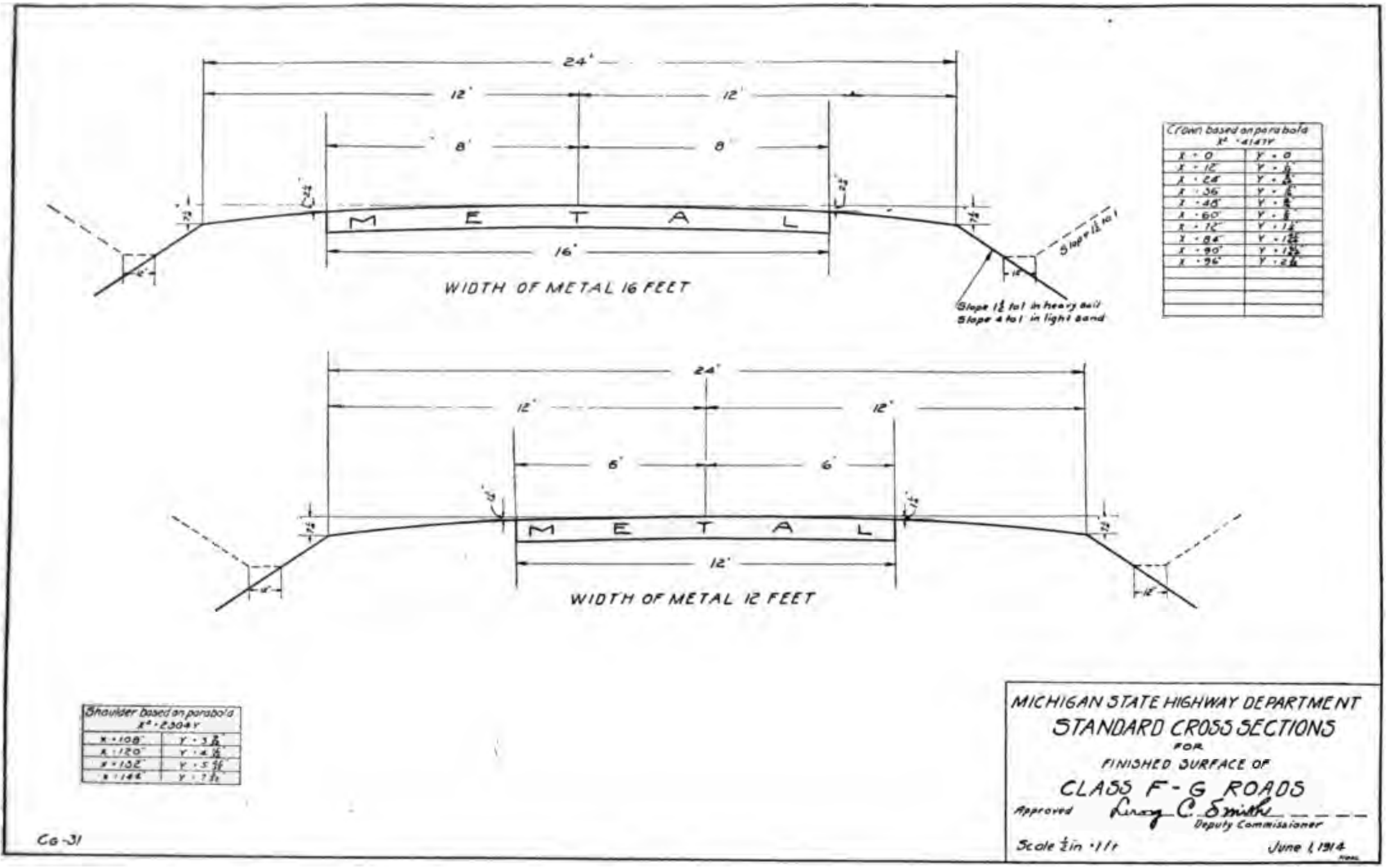
Care must be taken in finishing not to step on the concrete. All work shall be done from a bridge made expressly for the finishers to work from.

Removal of Forms.—Forms shall be removed when concrete has set. Immediately after removing the forms the edges of the concrete roadway shall be beveled to a horizonal width of three inches and a vertical depth of two inches by cutting off the edges with a sharp spade or flat sharp shovel.

Protection.—After finishing, the surface shall be kept well sprinkled with water, and as soon as the concrete has hardened sufficiently, the surface of the pavement shall be covered with a thin layer of dirt, or loam, which shall be kept wet at least five days by sprinkling with water.

Under the most favorable conditions for hardening in hot, dry weather, the pavement shall be protected from traffic for at least ten days, and in cool damp weather, for an additional length of time to be determined by the engineer or officers in charge.

Inspection.—During the laying of the concrete pavement, the local



Crown based on parabola X² = 4147Y	
X = 0	Y = 0
X = 12"	Y = [illegible]
X = 24"	Y = [illegible]
X = 36"	Y = [illegible]
X = 48"	Y = [illegible]
X = 60"	Y = [illegible]
X = 72"	Y = 1[illegible]
X = 84"	Y = 1[illegible]
X = 90"	Y = 1[illegible]
X = 96"	Y = 2[illegible]

Shoulder based on parabola X² = 2304Y	
X = 108"	Y = 3[illegible]
X = 120"	Y = 4[illegible]
X = 132"	Y = 5[illegible]
X = 144"	Y = 7[illegible]

MICHIGAN STATE HIGHWAY DEPARTMENT
STANDARD CROSS SECTIONS
FOR
FINISHED SURFACE OF
CLASS F-G ROADS
Approved Leroy C. Smith
Deputy Commissioner
Scale ½ in = 1 ft
June 1, 1914

officials shall provide for an experienced and competent inspector, who shall see that the specifications are carried out by the workmen. The qualifications of the inspector shall be such as to meet the approval of the State Highway Commissioner, and he shall be approved by said Commissioner.

STATE REPAIR FUND FOR STATE REWARDED ROADS.

HOW TO GET IT.

Section 16, Chapter V, Act No. 283, 1909, as amended 1913, reads as follows:

"On or before December first of each year a portion of the appropriation for State highway purposes, equal to two per centum of the total State rewards that may have been paid at that time, shall be credited to a repair fund which shall be paid out after December first of each year for repairs on State rewarded roads, in the same manner as State rewards are now paid: Provided, That such repairs shall have been made in accordance with specifications prepared by or approved by the State highway commissioner and that the amount so paid to any township or county shall not exceed two per centum of the total State reward money heretofore paid to such township or county, not counting any roads that may have been accepted and rewarded during the current calendar year."

Last year about two-thirds of all the rewarded roads complied with the State's requirements and received the repair fund. *It is expected that all will meet the requirements this year, for continued failure to do so will place the Township or County in a position where no further State rewards can be paid until the old roads are rebuilt and made good.*

To draw this repair money after December 1st, 1914, the following requirements must be complied with:

Roads of all classes, which need resurfacing, must be resurfaced during the summer or fall of 1914.

All damage to the shoulders by washing rains must be repaired.

All weeds and brush along the shoulders and in the ditches must be cut and removed from the roadway, or burned.

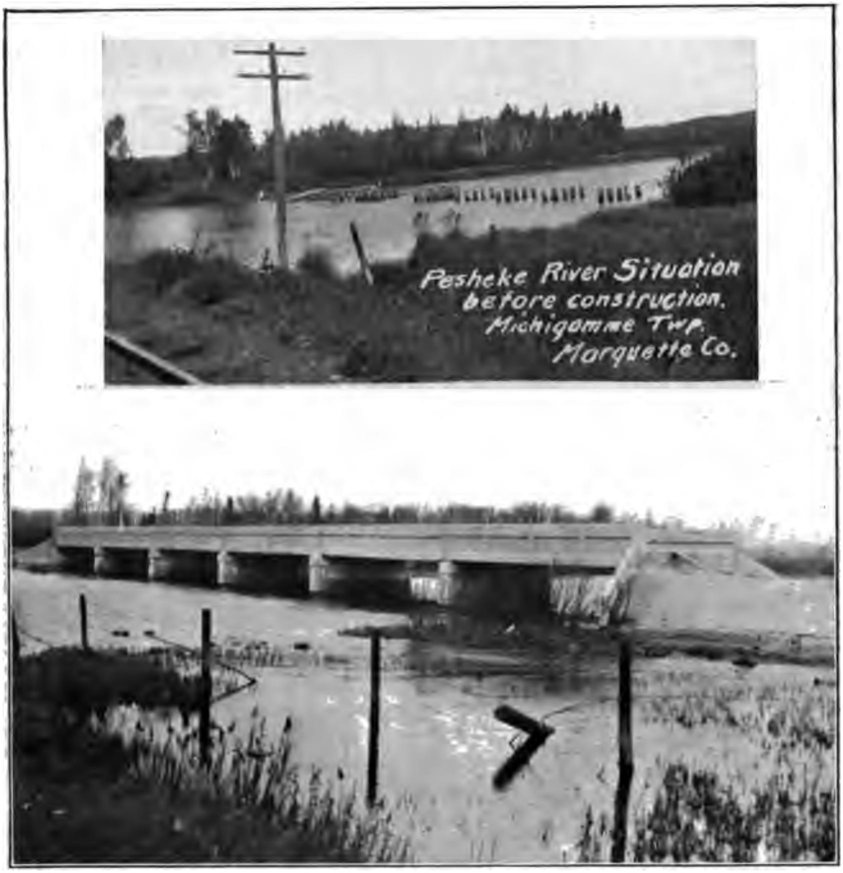
Where needed the ditches shall be cleaned out so as to give a free and uniform flow of water.

Outlets to road ditches must be cleaned out, if necessary, so as to remove all water from the road allowance.

THE ROAD DRAG.

For roads having earth or gravel surfaces (Classes A, B and C) suitable floating or dragging tools must be provided. They may consist of,—the plank drag or float, (cut of which is shown in Figure No. 1), the log drag or most any of the steel drags now on the market.

Neither the four wheeled grader nor the double steel drags requiring four horses to draw, will be accepted in lieu of the road drag for this purpose. They are too expensive to operate. It may be necessary how-



Peshekee River trunk line bridge in Marquette County, built under the trunk line law by the State Highway Department.

Upper view shows the situation before construction began.

Lower view shows the completed concrete girders, six spans at 40 feet each, making a 240 foot bridge. Reinforced concrete construction throughout, in which all steel is bedded in concrete, which makes an absolutely permanent structure.

For contract price, etc., see Trunk Line Bridge Table, Contract Number 1, page 100.

ever, to use the four wheeled grader at times, especially when the frost is coming out of the ground in the spring, to smooth down humps and fill slight depressions which the float will not do after the roads are once thoroughly compacted.

One drag or float must be provided for each continuous three miles of State rewarded road. If the road is four or five miles long, two drags must be provided. A drag must be provided for each disconnected piece of road if the distance between the far ends is more than three miles, otherwise one drag may be used for the separate pieces driving it over the connecting piece of unimproved road in going from one road to the other.

GRAVEL FOR REPAIRS.

A quantity of gravel of the same quality as that used in the surface of the road and amounting to 15 cu. yds. for each mile of State rewarded road, shall be delivered and compactly piled at some accessible point or points along the improved highway. Do not scatter the gravel along the highway in small piles near the traveled portion of the roadway. A separate pile of gravel shall be placed on each disconnected highway, and not more than enough gravel for three miles of highway shall be placed in one pile. In no case shall the gravel be placed so that it is necessary to drive over an unimproved piece of highway to reach the road.

PATCHING AND DRAGGING.

After placing the gravel and providing the road drags as above described, an arrangement must be made with some one living on the improved road or very close to it, to use the drag at the proper times, and to spread upon the road sufficient gravel to fill hollows and ruts when and where required. The following suggestions will be found helpful:

PATCHING.

This work is usually neglected or done in such a way as to cause two ruts to form where there was but one before. That is the invariable result of filling a rut too full. This work should always be done when the road is wet, *preferably when the water is still standing in every little hollow* on the road surface, so that the workmen can see just where to place the new gravel and about how much is required.

Unless the rut is a very large one, it is always best to shovel the gravel from the wagon into it, rather than to raise a side-board and attempt to dump a part of the load.

This kind of patching should never be done when the old road bed is hard and dry, for then the new material is soon ground into powder, making dust and mud.

WHEN TO DRAG.

(1) Begin in the spring when the frost has left the ground and the road begins to dry, but while yet soft.

(2) Drag immediately after every prolonged rain throughout the season.

(3) Drag in the fall just before the ground freezes.

(4) Drag in the winter if the frost leaves the ground. It will freeze smooth.

(5) Do not drag a dry road.

HOW TO DRAG.

(1) Hitch to the drag with a log chain, drawing it at such an angle as will crowd a little gravel towards the center of the road.

(2) If the drag cuts in too much, shorten the hitch; if too little, lengthen it.

(3) Let the team straddle the wheel track. Go down on one side and back on the other.

(4) Drive the team on a walk.

(5) Ride on the drag, unless the load is too heavy.

The success of this work depends solely upon the thorough manner in which it is followed up.

The telephone should be used to make sure that every man drags his beat on the appointed day.

On Class A roads of the sand-clay type the same materials (sand or clay, whichever was added to the original road) shall be provided, applied and dragged substantially as specified for gravel roads.

This year the repair money will be paid on Class A, B and C roads, unless they are so badly worn as to need a new surface, if the above requirements are complied with.

REPAIRS FOR MACADAM ROADS.

Macadam roads, which are badly rutted or humpy, should be scarified, reshaped and as much No. 2 stone and screenings added, as may be necessary, then watered and rolled until they have become thoroughly bounded, hard and smooth.

If the road does not need rebuilding, the hollows and ruts should be filled with No. 2 stone during the wet fall months and early spring months when the frost is leaving the ground.

Where there is continued heavy hauling over the roads, as in the sugar beet growing sections, arrangements must be made to keep the ruts continually full, so as not to allow the macadam crust to break through at any point. This will necessitate the steady employment of some person with team to make repairs during the heavy hauling season of October and November.

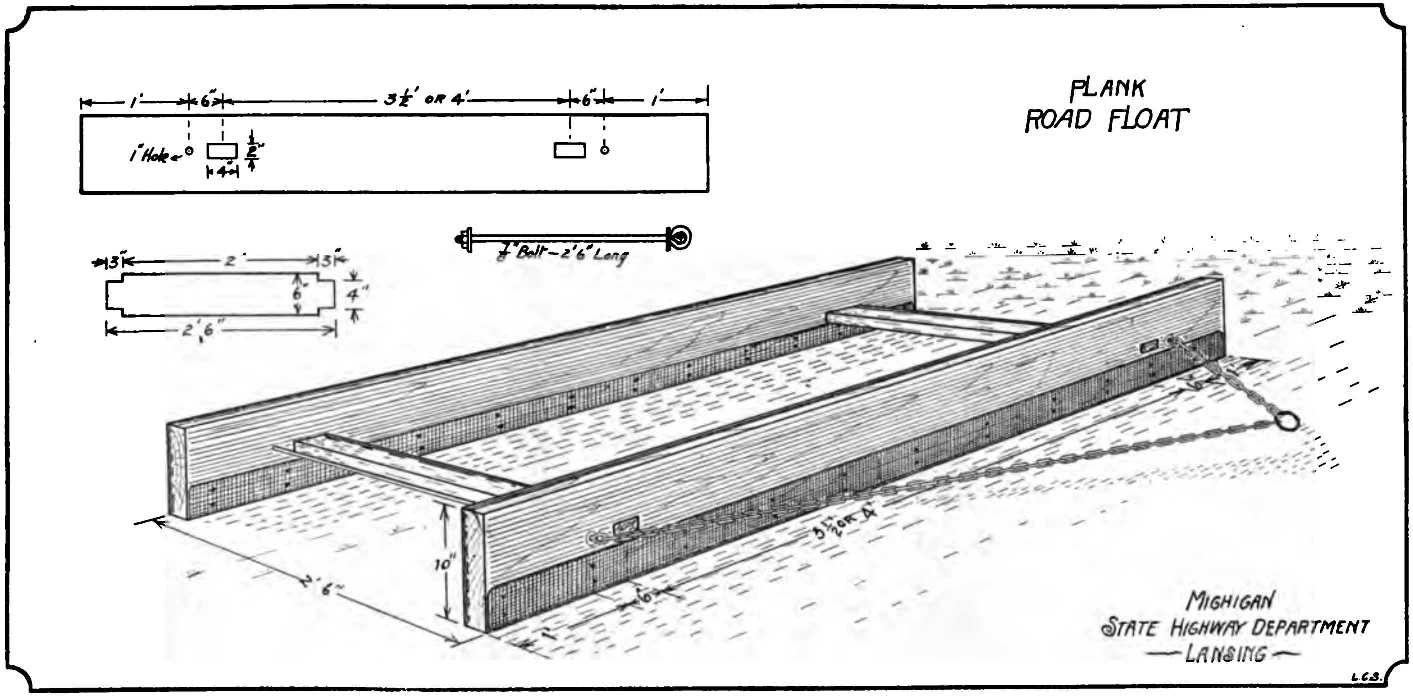
Before the first of December, a quantity of No. 2 stone and screenings, in the ratio of four tons of stone to one ton of screenings, shall be delivered and stored at some convenient point on State rewarded macadam roads. Not less than sixteen tons of stone and four tons of screenings, free from dust, for each mile of macadam will be considered sufficient.

Compliance with the above requirements with suitable arrangements for applying the stone needed for repairs during the early spring months, will entitle macadam roads to the State repair fund after December 1st, 1914.

CONCRETE ROADS.

Concrete roadways, which are in good condition and along which the shoulders and gutters are in perfect repair, will be entitled to the State repair fund after December 1st, as are other roads.

The rewarded roads in different parts of the State will be inspected as speedily as possible, and the proper officials notified of what special repairs may be necessary to make them eligible to the State repair fund.


PLANK
ROAD FLOAT
1'
6"
3½' OR 4'
6"
1'
1" Hole
4"
2"
3"
2'
3"
6"
4"
2'6"
⅞" Bolt–2'6" Long
10"
2'6"
3½' OR 4'
6"
1"
MICHIGAN
STATE HIGHWAY DEPARTMENT
—LANSING—
L.C.S.

ROYAL OAK ROAD REPAIRS.

The Woodward Avenue road between the Eight and Nine Mile roads in Royal Oak Township, Oakland County, was originally constructed by the township as a poured process bituminous macadam road, 16 feet wide. It wore to a bad surface, full of holes and ruts, and the township officials neglected to keep the same in repair. Under section 12, Chapter V of the State Reward Road Law, this depaartment requested the township officers to make the necessary repairs, which finally resulted in their passing a resolution allowing the State Highway Commissioner to go ahead with the work, using the State reward moneys due the township. The department had available $5,016.00, which was not sufficient to put the road in good shape, so funds were solicited by interested men in Detroit, Clarence H. Booth, James Couzens and Edwin S. George, who arranged for a subscription of $2,477.79 to assist with the work.

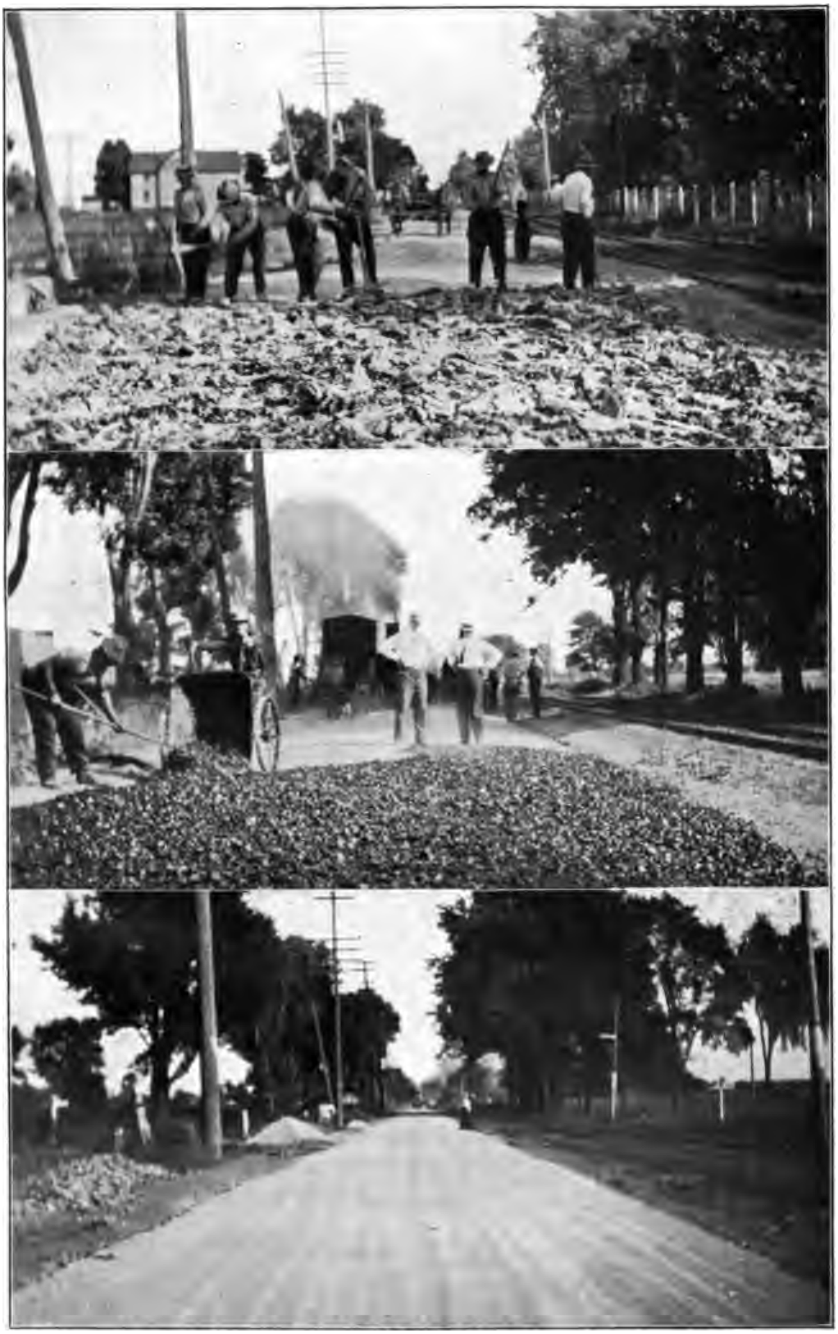
This department contracted with E. W. Seamans, of Grand Rapids, to tear up the old surface of the road, add new asphalt and stone, re-mix and re-lay the pavement, at seventy-three cents (73c) per square yard, plus extra asphalt needed for the squeegee coat. North of the Nine Mile Road, the surface was in fair shape, so it only was necessary to repair the worst places. The total cost of the work was $7,477.79.

This road is on the trunk line between Detroit and Pontiac, and receives a very heavy travel. A traffic record was taken on Saturday, August 15th, and the results for the day were as follows:

Single horse	34
Double team, light	15
Double team, loaded	35
Automobiles, runabouts	142
Automobiles, touring cars	994
Motor trucks (20% of which were more than 10 tons)	62
Motor cycle	73
Total travel between 7:00 a. m. and 9:00 p. m.	1,255

The record for Sunday, August 16th, is still greater:

Single horse	30
Double team, light	None.
Double team, loaded	15
Automobiles, runabouts	315
Automobiles, touring cars	1,912
Motor truck, bus	39
Motor cycles	179
Total travel between 7:00 a. m. and 9:00 p. m.	2,390



Woodward Avenue Road in Royal Oak township, Oakland county. Work directed by the State Highway Department. See account of same on opposite page.

It can be seen by the above records that the automobile traffic predominates.

The pavement laid will stand very well under ordinary automobile traffic, but the heavy trucks, ten to eighteen tons loaded with castings, which run between Detroit and Pontiac, are a very severe test on any type of bituminous pavement.

The Board of County Road Commissioners of Oakland County have agreed to take over the road as a county road and maintain it in the future.

PUBLIC MEETINGS.

The old law, which required the State Highway Commissioner to hold road meetings with the highway commissioners in each county in the State, has been repealed, and such meetings are now held only at such times and places as the State Highway Commissioner deems advisable.

DISTRICT MEETING.

For the past five years, an annual district meeting has been held at Traverse City for the road officials of Grand Traverse and the surrounding counties. These meetings were prompted and greatly assisted by Hon. Frank Hamilton, Chairman of the Grand Traverse County Road Commission.

These meetings proved so successful in the Grand Traverse region that similar road meetings were held this year at Kalamazoo and Flint, with results equally gratifying. It is probable that the plan will be extended another year so as to practically cover the State.

In the upper peninsula, the details of the county road work are almost wholly in charge of county highway engineers, who are employed by the several county road boards. These engineers, feeling the necessity of getting together at least once a year for the purpose of exchanging ideas, have organized an Upper Peninsula County Road Engineers' Association. The first meeting was held at Ishpeming in March, 1913, and was attended by Frank F. Rogers, then Deputy State Highway Commissioner. The second meeting was held at Iron Mountain in April, 1914, and attended by K. I. Sawyer, engineer-inspector of the State Highway Department. V. S. Hillyer of Marquette, is president of this association, and G. V. Carpenter, of Iron Mountain is secretary.

The smaller meetings have, for the most part, been abandoned, but the Commissioner and other members of the department have devoted a great deal of time attending farmers' institutes, farmers' clubs, granges and other public meetings where there has been a request to have road topics discussed.

During the fiscal year ending June 30th, 1913, Deputy Commissioner Rogers addressed 47 public meetings, and during the year ending June 30th, 1914, the Commissioner addressed 51 such meetings. Mr. L. C. Smith, Deputy Commissioner, addressed 5 meetings in 1913 and 6 meetings in 1914; William W. Cox, District Engineer, addressed 3 meetings in 1913 and 2 meetings in 1914; L. H. Neilsen, District Engineer addressed officials shall provide for an experienced and competent inspector, who shall see that the specifications are carried out by the workmen. The qualifications of the inspector shall be such as to meet the approval of the State Highway Commissioner, and he shall be approved by said Commissioner.

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To draw this repair money after December 1st, 1914, the following requirements must be complied with:

Roads of all classes, which need resurfacing, must be resurfaced during the summer or fall of 1914.

All damage to the shoulders by washing rains must be repaired.

All weeds and brush along the shoulders and in the ditches must be cut and removed from the roadway, or burned.

Where needed the ditches shall be cleaned out so as to give a free and uniform flow of water.

Outlets to road ditches must be cleaned out, if necessary, so as to remove all water from the road allowance.

THE ROAD DRAG.

For roads having earth or gravel surfaces (Classes A, B and C) suitable floating or dragging tools must be provided. They may consist of,—the plank drag or float, (cut of which is shown in Figure No. 1), the log drag or most any of the steel drags now on the market.

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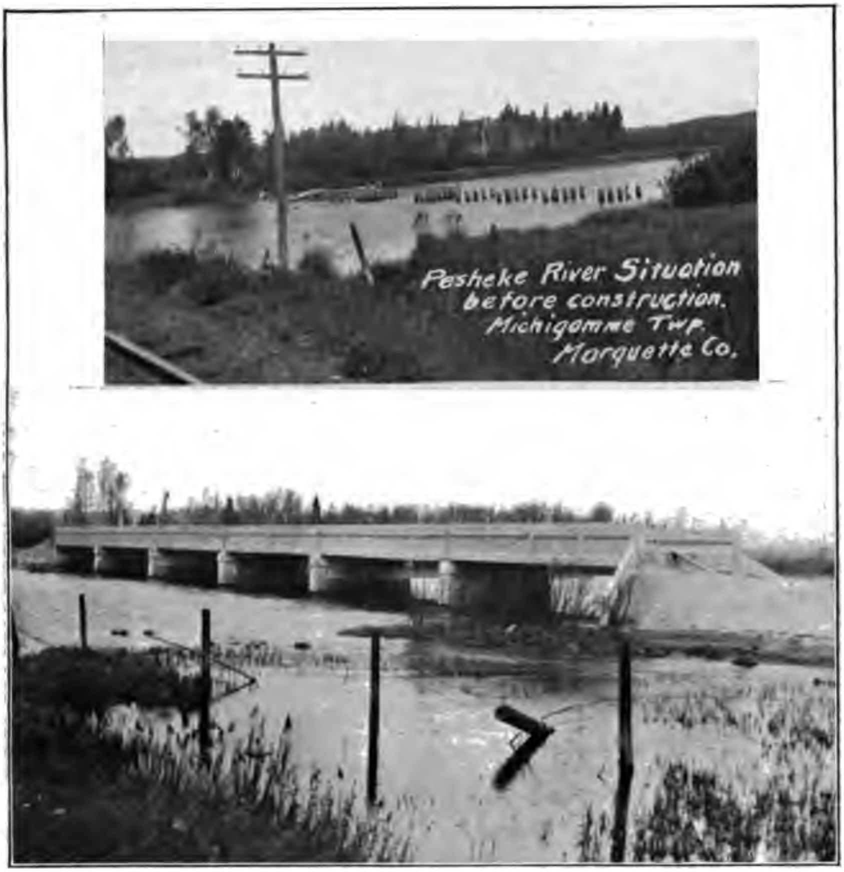


Peshekee River trunk line bridge in Marquette County, built under the trunk line law by the State Highway Department.

Upper view shows the situation before construction began.

Lower view shows the completed concrete girders, six spans at 40 feet each, making a 240 foot bridge. Reinforced concrete construction throughout, in which all steel is bedded in concrete, which makes an absolutely permanent structure.

For contract price, etc., see Trunk Line Bridge Table, Contract Number 1, page 100.

is very clearly shown from a recent report of the [illegible] Commission. In that State there are [illegible] crossings [illegible] which are unprotected [illegible] alarm bells or protecting devices.

In spite of this precaution [illegible] during the year. These figures show that [illegible] 26 railroad crossings [illegible] that one person was killed for every [illegible]

This means that the fatalities [illegible] 50 per cent greater than [illegible]. It might [illegible] of the fact that the travel is greater [illegible] in direct proportion to the travel [illegible] safe or hazardous.

In laying out Trunk Line Highways [illegible] been, wherever two alternate routes were [illegible] having the fewer or the safest railroad crossings. [illegible] where the railroad crosses near the [illegible] way has been shifted across the [illegible] ing a crossing altogether on the main line.

There are many places in the State [illegible] might be obtained from proper cooperation with the [illegible] way officials. It would seem that there might be [illegible] the highway laws making it possible for [illegible] to meet railroad companies and [illegible] further seen that the Railroad Commission [illegible] ment might be empowered to order the [illegible] hazardous crossings and some means [illegible] and Township could contribute to that [illegible] portion of the Highway.

An important elimination of grade crossings has been made [illegible] Calhoun County Road Commissioners in [illegible] Township [illegible] highway crossed the [illegible] a dangerous [illegible] Railroad. [illegible] one thousand feet crossed the [illegible] Railroad. The [illegible] crossings were particularly hazardous. [illegible] and [illegible] to go under the [illegible] tracks on a new reinforced concrete bridge. [illegible] a plan and profile showing what has been done [illegible] the opposite page. You will find a photograph [illegible] the new concrete bridge was built [illegible] road, and later after it had been [illegible]. The local officials deserve credit for doing this [illegible].

is very clearly shown from a recent report of the New York Railroad Commission. In that State there are 8,780 railroad crossings, 6,497 of which are unprotected and 2,283 of which are protected by flagmen, gates, alarm bells or derailing devices.

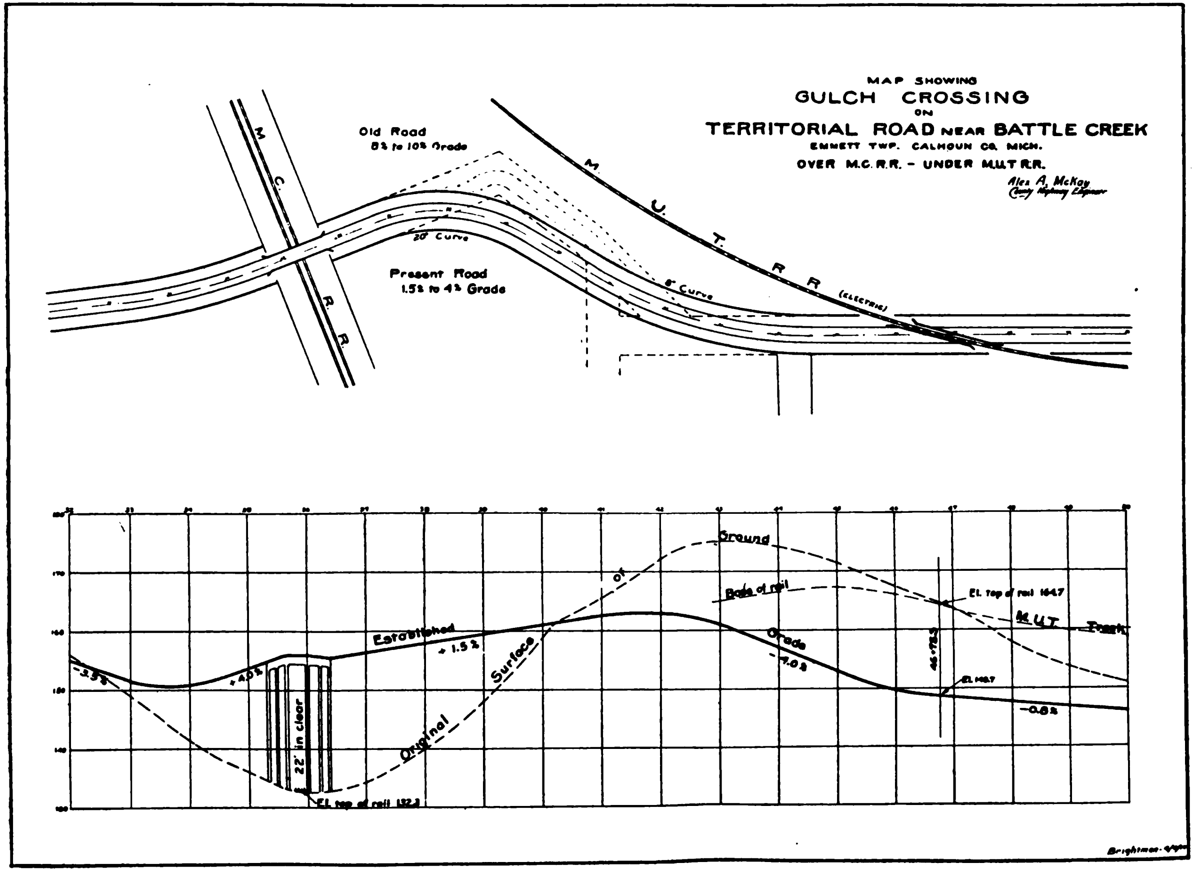
In spite of this precaution 116 people were killed and 223 injured during the year. These figures show that one person was injured for every 26 railroad crossings, including those protected as above noted and that one person was killed for every 76 railroad crossings.

This means that the fatalities per crossing in New York State are about 50 per cent greater than in Michigan which must be attributed wholly to the fact that the travel is greater, for the accidents must be almost in direct proportion to the travel, providing the crossings are equally safe or hazardous.

In laying out Trunk Line Highways the policy of this Department has been, wherever two alternate routes were available to choose the one having the fewest or the safest railroad crossings. In some instances where the railroad crosses near the corner of the section a new right of way has been secured across the corner parallel to the track, thus avoiding a crossing altogether for the main line.

There are many places in the State where over or under crossings might be obtained from proper co-operation with the railroad and highway officials. It would seem that there might be some improvement in the highway laws making it easier for highway officers to raise the funds to meet railroad companies half way on these propositions. It would further seem that the Railroad Commission and the Highway Department might be empowered to order the separation of grades at extra hazardous crossings and some means provided whereby the State, County and Township could contribute to that part of the expense that should be borne by the Highway.

An important elimination of grade crossings has been made by the Calhoun County Road Commissioners in Emmet township, where the highway crossed the electric line at a dangerous place and then within one thousand feet crossed the Michigan Central Railroad. These two crossings were particularly hazardous. The highway grade has now been laid so as to go under the M. U. T. tracks and over the Michigan Central tracks on a new reinforced concrete bridge. On page 92 will be found a plan and profile showing what has been done at this situation, and on the opposite page, you will find a photograph showing the situation before the new concrete bridge was built over the Michigan Central Railroad, and later after it had been finished and part of the fill completed. The local officials deserve credit for having this change made.


MAP SHOWING
GULCH CROSSING
ON
TERRITORIAL ROAD NEAR BATTLE CREEK
EMMETT TWP. CALHOUN CO. MICH.
OVER M.C.R.R. - UNDER M.U.T.R.R.
Alex A. McKay
County Highway Engineer
Old Road
8% to 10% Grade
Present Road
1.5% to 4% Grade
20° Curve
8° Curve
M. C. R. R.
M. U. T. R. R. (ELECTRIC)
Ground
Base of rail
El. top of rail 164.7
M.U.T. Track
46+78.5
El. 148.7
-0.8%
Grade
-4.0%
Established
+1.5%
Original Surface of
+4.0%
-3.5%
22' in clear
El. top of rail 132.3
180
170
160
150
140
130
32
33
34
35
36
37
38
39
40
41
42
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49
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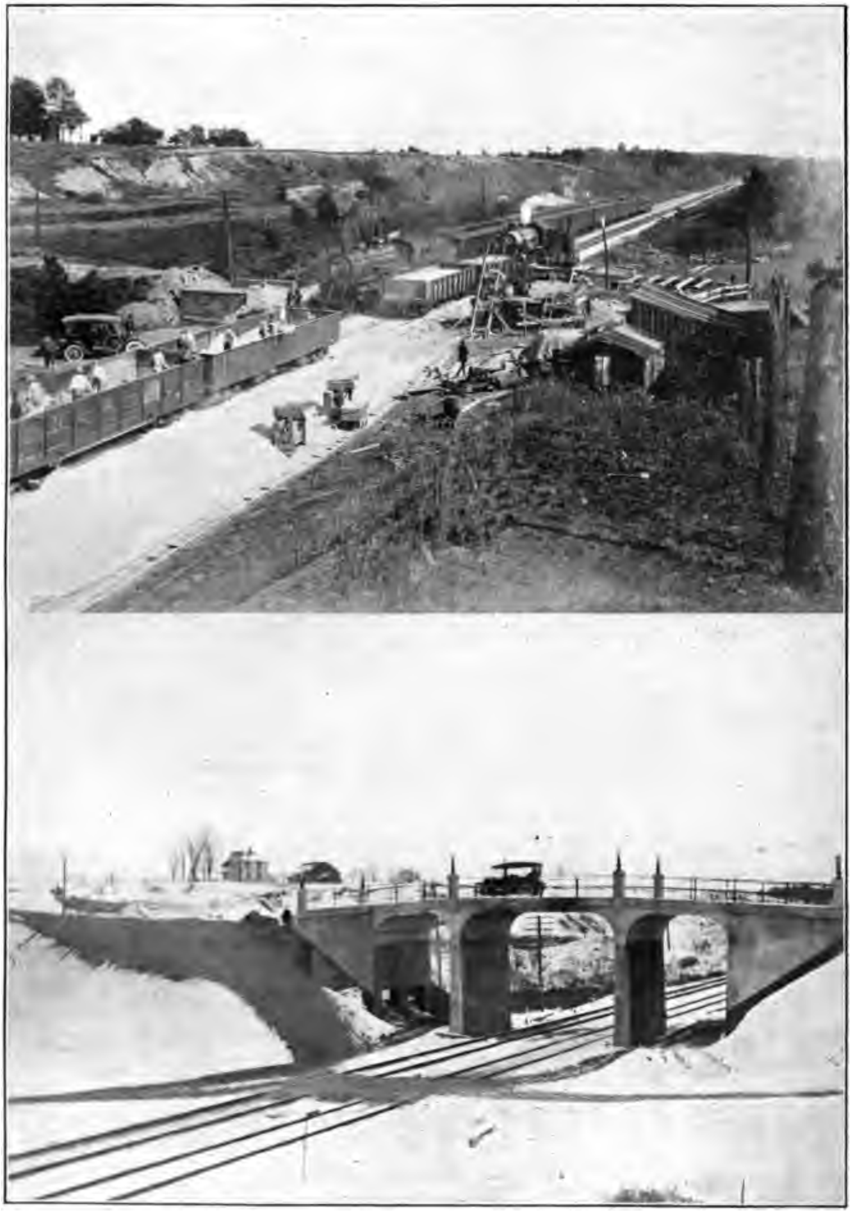
Brightman



Overhead crossing in Emmet township, Calhoun county, on the Territorial Road over the **Michigan Central tracks.** Reinforced concrete structure.

ROAD BEE DAY.

JUNE 4TH AND 5TH, 1914.

For the first time in Michigan History, an official Road Bee Day was proclaimed. Governor Ferris issued the proclamation which is reprinted on the following page.

Much good resulted from the work which was well organized in many localities in the State.

Community interest in public work has lagged somewhat since the "Cash tax" law took the place of "Statute Labor." This interest was renewed, and different "gangs" tried to make their section better than their neighbors'.

Although it rained one of the days appointed, other days were selected by different associations to finish the work so well started.

This Department believes Road Bee Day was a success and should be an annual affair.

The following is a copy of the Proclamation issued by Governor Ferris, and letter sent to all road officials by this Department.

STATE OF MICHIGAN

ROAD BEE DAY

June 4 and 5, 1914

A Proclamation: By the Governor.

In 1913 the townships of Michigan raised $4,336,029 for the improvement and repair of highways; 44 counties under the county road system levied county road taxes amounting to $1,621,681 and the State appropriated $800,000 for the payment of State rewards, making a grand total of $6,757,710 which was raised by direct taxation and expended on the rural highways. Added to this, many townships and counties raised money by bonding and many public spirited citizens gave freely in money and labor, so that it is a low estimate to say that at least seven millions of dollars were expended on Michigan's roads during the past year.

While this has resulted in the building of more miles of excellent highways than were ever before built in a single year, there is still much to be desired. The people want more good roads and want all of the roads cared for better than they have been in the past.

Last year on June 9th the Huron Shore Road Association observed the first "Road Bee Day" ever held in this State. It was a success; wet pieces of road were drained; logs, roots, stumps and stones were removed from the roadway; bad stretches of clay were sanded; bad pieces of sand were clayed; gravel was hauled; road drags were set to work and altogether so much enthusiasm was aroused that many farmers put in a full week instead of one day. By this concerted effort some 200 miles of highway in eastern Michigan, which in some places was very bad, was made into a very passable road.

At the request of the Michigan Good Roads Association, the Huron Shore Road Association and the Western Michigan Pike Association, and to the end that this good work may extend over the State and all the people receive the benefits, I, Woodbridge N. Ferris, do ask that the people of the State of Michigan set apart Thursday and Friday, June 4th and 5th, 1914, as "Road Bee Day," and as far as possible turn out and work under well planned and competent supervision on the highways of this State in such manner as shall make them more fit, safe and pleasant for public travel.

Given under my hand and the Great Seal of the State this thirteenth day of May, in the year of our Lord one thousand nine hundred and fourteen and of the Commonwealth the seventy-eighth.

WOODBRIDGE N. FERRIS,
Governor.

By the Governor:
Frederick C. Martindale,
Secretary of State.

TO ROAD OFFICIALS.

May 15, 1914.

Gentlemen:—With the Governor's proclamation calling for a State wide "Road Bee Day" on June 4th and 5th, there is open to you an opportunity to organize the forces in your community for two days of a real campaign against the bad places in your highways, and a corresponding responsibility if this opportunity is neglected.

DON'TS.

Don't try to do too much.

Don't start more than you can finish. You cannot build a macadam road, nor very long stretches of gravel road in two days.

Don't haul gravel onto roads that have not been properly graded and drained.

Don't grade roads that have not been properly staked out on correct lines.

Don't plow up long stretches of road and leave them impassable.

Don't scrape sods onto the traveled roadway and leave them for passing vehicles to smooth down.

WHAT MAY BE DONE TO ADVANTAGE.

You can remove logs, rocks, stumps and stones from the roadway; fill holes, preferably with good earth; cover stretches of sand with clay or gravel; drain wet places in the roadway; scrape off and outwards sod margins where they hold the water in the traveled track. When drained and graded, clay may be covered with sand or gravel, but the

Marshall Road north of Coldwater, built by Branch County Road Commission.
Bottom course gravel, 16 feet wide, being used for travel.
Top course of screened gravel will be added later.
Weeds have been cut since photograph was taken.

Township road in Reading township, Hillsdale county. Nine foot gravel.

gravel should not contain any clay unless it is to be placed on sand. Culverts may be repaired, or new culverts put in.

Road drags (of planks or split logs) should be made and arrangements perfected for using them after rains, throughout the season, on all clay and loamy soils.

ORGANIZATION.

All these things will be of great value to the roads of the State, but they will not be accomplished unless the work is well planned and performed under intelligent supervision. Let each community organize by road or school districts and appoint the best road builder in the neighborhood as "road boss" for two days, and then turn out and work loyally under his direction. See how much real good can be done to the roads in your district and by the concerted efforts of every district to the 70,000 miles of rural highways in Michigan. Let us all give this first State wide "Road Bee Day" an honest, earnest trial.

FRANK F. ROGERS,
State Highway Commissioner.

SAVE THE SHADE TREES.

Frequently one of the most troublesome questions in regrading old roads is—How can we save the shade trees?

In the older sections of the State most of the early settlers built their homes and farm buildings on the higher elevations of land along the highways. They set out shade trees and otherwise improved the road sides at great expense. Many of these trees are older than the present generation, and to destroy them unnecessarily is little less than a crime which should be punishable by law, even though this work is done by a highway commissioner in an attempt to reduce the grades on the highway.

It would be a waste of time and money to lay expensive road surfaces over hills so steep that large loads could not be drawn over them after the roads are improved. However, great care should be exercised by engineers in laying grades and by commissioners in following them, so that the least damage possible will be caused to existing buildings, drive ways to farm residences, barns, shade trees and other improvements which may have been made along the road sides. With due care in the laying of grades and more care in excavation, nearly all of the trees along the road sides can be saved, particularly those which have been planted for shade trees, as well as many of the natural trees which have been left for that purpose.

Before any grading is done in such places, guide stakes should be carefuly set, showing the greatest distance out from the center to which it is necessary to excavate in order to make a reasonable slope to the embankment, and the utmost care taken not to damage the roots of trees beyond the lines thus marked.

If grading is being done for state reward roads, the State Highway

Commissioner or some of his assistants should be consulted before destroying important shade trees along the road sides, even though at first it might seem necessary. Many states are spending large sums of money in planting trees to beautify the road sides, but Michigan has been backward in this work. The State Highway Department desires to co-operate with the officials and owners of property along the lines of roads that are being built, to the end that existing improvements shall be interfered with as little as possible, and that other improvements may be made, so that the landscape will be beautified rather than marred when new roads are completed.

INTER-COUNTY DRAINS.

As noted in the previous report of this department, Act 185 of the Public Acts of 1911, amended the drain laws of this State so that the State Highway Commissioner is now arbitrator on drains affecting more than one county whenever the County Drain Commissioners cannot agree: (1) On the necessity; (2) On the location of; (3) On the division of benefits between the counties affected; (4) On any other matter relative thereto. See sections 2, 3, and 4 of Chapter 7, Compiled Drain Laws.

Under the provisions of the above act, proceedings on ten drains have come to the State Highway Commissioner for arbitration or advice during the past two years. They are as follows:

(1) Dietline Drain, affecting Bay and Midland Counties.

Application received December 24, 1912; decision rendered January 13, 1913. The petition was not granted on account of an insufficient outlet at the lower terminus of the proposed drain.

(2) Robbins Drain, affecting Bay and Saginaw Counties.

Application received March 1, 1913; decision rendered April 8, 1913. Petition was not granted on account of an insufficient outlet at lower terminus of drain as proposed.

(3) Reynolds Drain and Extension, affecting Clinton and Ingham Counties.

Application received March 11, 1913, asking for a determination of the per cent of benefits between the counties named. Decision was rendered April 24, 1913, apportioning Clinton County with 93% and Ingham County with 7% of the cost of constructing said drain.

(4) Ott Drain, affecting Bay and Midland Counties.

Application received June 23, 1913, to apportion the per cent of benefits between the above named counties. Decision was rendered July 26, 1913, assessing Midland County 31% and Bay County 69% of the cost of said drain.

(5) Birch Creek Drain, Saginaw County.

Application was received July 24, 1913, asking advice regarding the best method of taking care of the flood water near the outlet of said drain which is in Flint River.

The question was referred to Mr. R. W. Roberts, Civil Engineer, Saginaw, Michigan, who made a thorough examination and recommended that a new outlet be made in the Cass River about 4 miles northwesterly from the present outlet and that the present outlet be closed.

The Commissioner concurred in the above recommendation and the report was made August 12, 1913.

(6) Cass River Drain, affecting Sanilac and Tuscola Counties.

Application was received December 1, 1913. On March 1, 1914, Mr. K. I. Sawyer, an engineer of this department, working under the direction of the Commissioner, made a report of his observations, recommending that the examination was not entirely satisfactory on account of high water and that another trip over the drain be made during low water the coming summer. This second examination had not been made at the close of the present fiscal year.

(7) Alabaster Drain, affecting Arenac and Iosco Counties.

Application was received December 3, 1913. Examination was made by K. I. Sawyer, an engineer from this department, working under the direction of the Commissioner. He reported on January 7, 1914, that a further survey would be required to secure the information for a satisfactory determination.

Such survey had not been completed at the close of the present fiscal year.

(8) Marion Township Drain, affecting Clare and Osceola Counties.

Application was received December 26, 1913. The drain was visited by K. I. Sawyer, an engineer from this department, acting under the direction of the Commissioner. On January 22, 1914, he effected a settlement in the case, both commissioners agreeing that Osceola County should bear 57% of the cost, and Clare County 43% of the cost of said drain.

(9) Swan Creek Drain, affecting Saginaw, Midland, and Gratiot Counties.

Application was received February 11, 1914, to apportion the benefits among said counties.

Careful examination of the lands benefited was made by L. H. Belknap, an engineer of this department, working under the direction of the Commissioner, and a report was made March 7, 1914, apportioning 70% of the cost of said drain to Saginaw County, 23% to Midland, and 7% to Gratiot.

(10) Countegan Drain, affecting Saginaw and Bay Counties.

Application was received June 13, 1914, to determine the per cent of benefits that should be assessed to each of said counties.

Determination had not yet been made at the close of the present fiscal year.

STANDARD BRIDGE PLANS.

On the following pages can be found small electro-type prints of the standard bridge plans, prepared for distribution among township and county officials by this department. Large blue prints of these plans may be had upon application.

Attention is called to plan BL-401, which is the plan for concrete head-walls for vitrified or concrete tile and tubular culverts. These head-walls cost but little and add greatly to the life of any small culvert. Table of dimensions of culverts necessary for different depths of fill on a twenty-four foot turn-pike, is shown.

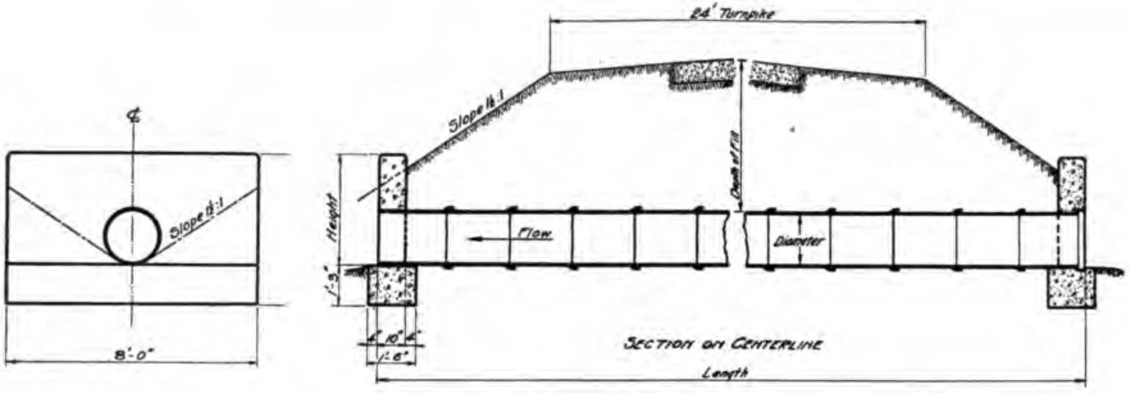
Reinforced concrete box culvert from 18 inches to 3 feet square is shown in plan BK-15. This type of construction is more permanent than concrete or vitrified tile, or metal tubes, and does not cost much more to construct.

BK-8 shows plan for 3 to 5 foot span and BK-7 shows 6 to 15 foot span reinforced concrete culverts and small bridges. The different sizes for different spans and heights of abutment is found in the table in the upper left-hand corner of the drawing. The letters across the top show the dimensions for concrete and give the estimated yardage for different sizes. In the lower left-hand corner is the table giving the steel sizes for different spans of culverts.

This department calls particular attention to BK-11, standard abutment plan for I-beam bridges of different heights of wall. These are plain concrete abutments and are adaptable to almost any ordinary highway bridge construction.

BK-13 is a standard plan for I-beam deck, to be used with plain concrete abutment. We recommend the use of only four I-beams spaced 4 feet 8 inches centers for a 16 foot clear roadway. These I-beams are not drilled, punched or fabricated in any way, simply plain rolled beams, cut to length and can be purchased for 2c per pound or less. We recommend a reinforced concrete floor 7 to 8 inches thick on these beams and the builder can either select a gas pipe railing or a concrete rail. In the table on this plan can be found complete bill of material for any size of span, from 8 to 42 foot length of I-beam.

Advice on bridge work, even to the extent of sending a man to make the survey and furnish plans and specifications for large bridges, is furnished by this department free to townships and counties.



SECTION ON CENTERLINE

Dimensions of Head Wall

Diameter of Culvert	Height	Cu. Yds in one Head Wall
12"	3'-0"	1.26
15"	3'-3"	1.31
18"	3'-6"	1.38
24"	4'-0"	1.43

Note— Vitrified or concrete tile must be laid in cement mortar.
Iron or steel tubes of heavy gauge can be used in place of tile as shown.
Concrete— 1:3:6 Mix.
Concrete to be in accordance with the Michigan State Highway Department Specifications for Steel and Concrete Highway Bridges, Edition 1914.

Length of Culvert for varying depth of fill

Depth of Fill	2'	3'	4'	5'	6'	7'	8'	9'	10'	11'	12'	13'	14'	15'
Length of Cul.	26'	28'	32'	34'	38'	40'	44'	46'	50'	52'	56'	58'	62'	64'

MICHIGAN STATE HIGHWAY DEPARTMENT
STANDARD PLANS OF CONCRETE HEAD WALLS
FOR
12"-15"-18" OR 24" PIPE CULVERTS
Scale—½"=1'-0" Apr. 1914
Correct C. V. Dewart
Bridge Engineer
Approved Leroy C. Smith
Deputy Commissioner

BL-401

TABLE NO. 10.—*State*

Contract.	Crossing.	County.	Township.	Type.	Span. Ft.
1	Pesheeke River	Marquette	Michigamme	Concrete girders	6 at 40
2	Chovin Creek	Wayne	Springwells	I-Beam	2 at 24
3	Plaster Creek	Kent	Wyoming and Paris	Concrete arch	50
4	Shiawassee River	Shiawassee	Rush and New Haven	Concrete arches	2 at 80
5	Rush Creek	Ottawa	Georgetown	Through girders	55
6	Rush Creek	Ottawa	Georgetwon	I-Beam	40
7	Red Cedar River	Ingham	Meridian	Through concrete girders	2 at 41
8	Pike River	Houghton	Chassell	I-Beam	38
9	Snake River	Houghton	Chassell	I-Beam	38
10	Carp River	Emmet	Carp Lake	I-Beam	36
11	Rouge River	Wayne	Redford	Deck girder	82
12	Bowen Creek	Manistee	Arcadia	I-Beam	34
13	Titabawassee River	Midland	Jerome	I-Beam (Approaches)	2 at 38
14	Fortune Lake	Iron	Crystal Falls	I-Beam	38
15	Black River	Gogebic	Wakefield	I-Beam	42
16	Whitefish River	Delta	Masonville	Through girder (Approaches)	2 at 80
17	Scotts Creek	Alger	Mathias	Concrete arch	40
18	Duck River	Gogebic	Watersmeet	I-Beam	38
19	Pentwater River	Oceana	Weare	Through girders	70
20	Sink Hole	Newaygo	Sherman	I-Beam	40
21	Hickory Creek	Berrien	St. Joseph	Through girders	70
22	Michigamme River	Iron	Mansfield	Concrete arch	85

Trunk Line Bridges

Clear roadway. Ft.	Approximate cubic yards of concrete.			Contract awarded to—	Amount.	Total.
	Plain.	Reinforced.	Total.			
16	....	600	600	Powell & Mitchell, Marquette, Mich	$11,129 70	$11,129 70
22	....	119	119	G. F. Bristol Wayne County Road Commissioners American Bridge Co., Detroit, Mich	2,842 00 423 00 790 00	4,055 00
36	....	....	600	Illinois Bridge Co., Chicago, Ill	6,063 09	6,063 09
18	....	....	800	Illinois Bridge Co., Chicago, Ill	9,282 00	9,292 00
18	199	32	231	Bad Axe Crushed Granite Co., Bad Axe, Mich Central States Bridge Co., Indianapolis, Ind	2,079 00 1,379 00	3,458 00
20	51	33	84	Bad Axe Crushed Granite Co., Bad Axe, Mich Jarvis Engine & Machine Works, Lansing, Mich	895 00 241 60	1,136 60
18	171	122	293	M. E. Fitzpatrick, Lansing, Mich	4,485 00	4,485 00
20	43	31	74	Smith, Byers, Sparks Co., Houghton, Mich Jarvis Engine & Machine Works, Lansing, Mich	1,197 20 261 44	1,458 64
20	88	31	119	Smith, Byers, Sparks Co., Houghton, Mich Jarvis Engine & Machine Works, Lansing, Mich	1,555 40 261 44	1,816 84
20	52	30	82	Bad Axe Crushed Granite Co., Bad Axe, Mich Jarvis Engine & Machine Works, Lansing, Mich	990 00 229 68	1,219 68
20	....	268	268	Wm. J. Meagher & Co., Bay City, Mich American Bridge Co., Detroit, Mich	5,600,00 2,139 00	7,739 00
20	69	29	98	Small Bros. Bridge Co., Lansing, Mich Jarvis Engine & Machine Works, Lansing, Mich	1,307 00 212 16	1,519 16
18	254	45	299	E. C. Nolan & Son, Evensville, Mich Jarvis Engine & Machine Works, Lansing, Mich	5,582 00 465 12	6,047 12
20	58	31	89	D. F. Boyle, Crystal Falls, Mich Jarvis Engine & Machine Works, Lansing, Mich	1,484 00 261 44	1,745 44
20	134	34	168	Gaffin & Gehri, Fon du Lac, Wis Jarvis Engine & Machine Works, Lansing, Mich	2,689 00 288 96	2,977 96
18	190	96	286	Chas. E. Nebel, Gladstone, Mich Central States Bridge Co., Indianapolis, Ind	3,246 00 4,090 70	7,336 70
18	....	....	94	Illinois Bridge Co., Chicago, Ill	1,647 00	1,647 00
20	102	31	133	D. F. Boyle & Co., Crystal Falls, Mich Jarvis Engine & Machine Works, Lansing, Mich	1,760 00 326 80	2,086 80
18	165	44	209	....	....	....
20	30	32	62	....	....	....
18	160	44	204	....	....	....
18	400	237	637	....	....	....

Total Trunk Line Bridges Contracted, June 30, 1914—$75,203.73.

DIGEST OF IMPORTANT OPINIONS ON ROAD LAWS BY THE ATTORNEY GENERAL.

OVERSEER TO ACT UNDER THE DIRECTION OF THE TOWNSHIP HIGHWAY COMMISSIONER.

"Section 40 of the general highway laws of the State, among other things, provides that the overseers of highway shall from time to time report to the commissioner any defects in the highways within their respective districts, and shall, *when required by the commissioner, supervise the working, or repairing of roads, and the building, and repairing of bridges therein.* Section 42 of said general highway laws of the State, among other things, provides that the commissioner of highways of the township shall employ and direct the employment of such labor as he may deem necessary and advisable, and all disbursements from the highway improvement funds or the road repair fund shall be made upon his warrant drawn on the township treasurer and countersigned by the township clerk.

It is apparent from the two sections above referred to that overseers of highways are under the direction and are to a certain extent subject to the control of said highway commissioner in the building or repairing of the highways of the township. The last mentioned section seems to specifically provide that the highway commissioner shall draw all orders for the payment of labor performed and all disbursements made from the highway improvement fund or the road repair fund, the same to be drawn upon the township treasury and countersigned by the township clerk. It necessarily follows that the highway order drawn upon either one of the aforesaid funds not signed by the highway commissioner would be invalid."

CAN STATE REWARD MONEYS BE USED FOR OTHER PURPOSES THAN THE PAYMENT OF BONDS IN TOWNSHIPS WHICH HAVE BONDED FOR BUILDING STATE REWARD ROADS?

Chapter V, Act 148, Public Acts of 1911 contains the following clause:

"In case the road building money was raised by the sale of bonds the State reward money shall be used *only* for the payment of the principal of the bond."

Again, the same section was amended by Act 355, Public Acts of 1913, omitting the above clause.

This latter act took effect August 15th, 1913. Therefore, any Township which voted to bond before that date would have to pay all State reward moneys received upon the bonds outstanding against the township and any township which bonded since that date could use their state reward money for the purpose of making further road improvements in the township.

SURVEY OF ROADS BEFORE IMPROVEMENT.

"It seems to be the intent of the general highway law of 1909 as indicated by various provisions thereof, to require such survey to be made before any other work is commenced. No doubt such survey was deemed necessary by the Legislature in order that the line and grade of the proposed road and the boundaries thereof should be definitely fixed before work of permanent character thereon is undertaken. Therefore, I would suggest that the survey be made before other work is started."

CUTTING OF BRUSH AND NOXIOUS WEEDS.

"Chapter 24 of the general highway law controls this matter. This Department has taken the view, however, that the provisions relative to the cutting of brush did not authorize the spreading of the expenses thereof against the land crossed by the highways within the limits of which the brush is cut. This holding is based upon the proposition that the act does not impose any duty upon the owner of the land to cut such brush. It will be noted further in this connection that section 3 relates solely to the cutting and destruction of noxious weeds rather than to brush. Accordingly, it follows that the cost of cutting brush within the limits of any highway should be paid by the township board out of any moneys belonging to the general township fund. With reference to noxious weeds, however, the provisions of the statute imposing the duty and providing for the penalty are clear. Section 7 reads as follows:

> 'The supervisor of the township shall add to all such expenditures as have been so audited and allowed ten per centum of the amount of such expenditures and shall cause all such expenditures, together with the additional ten per centum, to be severally levied on the lands on which such expenditures were made, and the same shall become a lien upon said land and shall be collected in the same manner as other township taxes are collected; the same when collected shall be paid into the general township fund to reimburse the outlay therefrom aforesaid.'

It follows from this section that money expended for the destruction of noxious weeds in accordance with the provisions of the chapter, is to be levied against the land."

COST DATA ON STATE REWARD ROADS.

In the following pages is printed a table showing the average cost per mile and the percent of State reward paid on all State reward roads built since 1905, when the State Highway Department was organized. The source of information for this table is the cost sheets rendered by the different township and county road officials throughout the State.

In examining this table it must be borne in mind that no note is made of difficult grading jobs, long hauls of material, etc., so that there may be costs of gravel road 9 feet wide running up as high as $2,500 or $3,000 per mile, while the average cost of such road does not run much above $1,900 per mile. Again some gravel road costs may run as low as $1,200 per mile where there is practically no grading except turn-piking and where the gravel pit is right beside the road. However, the average obtained from all the road of a certain class built in a county, would be a fairly good basis to estimate the cost of constructing similar roads.

The class and width mentioned in this table is the class and width upon which state reward was paid. Often the width of roadway was built greater than the reward paid would show, this being due to the fact that the law would not allow the payment of added reward for additional width of metal track until 1913.

Trunk line double rewards, and rewards of fifty percent additional, due to the road becoming a part of the state trunk line, are included in figuring the percent of state reward paid, and in each case that these added rewards are included, the same is noted at the right hand edge of the table.

TABLE NO 11.

County.	Class and width. Ft.	Miles.	Total cost.	Average cost per mile.	Per cent state reward paid.	Remarks.
Alger.........	*E-9	8.551	$66,247 14	$7,747 29	12.907	
Total.......	......	8.551	$66,247 14	....	....	
Allegan.......	A-9	0.800	$880 00	$1,100 00	22.727	
	B-9	0.804	1,321 58	1,643 75	30.418	
	B-10	0.500	779 65	1,559 30	35.273	
	C-9	2.503	5,818 69	2,324 68	32.258	
	E-9	4.608	22,894 48	4,848 88	20.127	
Total.......	......	9.215	$31,694 40	....	....	
Antrim.......	B-9	42.733	$101,048 18	$2,364 65	21.146	
	C-9	1.004	2,954 59	2,942 82	25.485	
	D-9	4.663	10,505 17	2,252 88	33.288	
Total.......	......	48.400	$114,507 94	....	....	
Arenac........	B-9	1.010	$1,895 00	$1,876 24	26.649	
	B-12	1.013	2,868 03	2,831 22	22.946	
Total.......	......	2.023	$4,763 03	....	....	
Barry.........	B-9	34.384	$63,795 63	$1,855 37	26.949	
	B-16	2.006	7,530 65	3,753 76	45.281	Trunk line, double reward.
Total.......	......	36.390	$71,326 28	....	....	
Bay..........	B-9	0.996	$2,900 86	$2,912 51	17.167	
	C-9	1.000	3,602 59	3,563 21	20.929	
	E-9	57.419	228,062 30	3,971 89	25.176	
	F-9	0.161	1,341 70	8,345 96	11.999	
Total.......	......	59.576	$235,907 45	....	....	
Benzie........	B-9	38.982	$83,994 73	$2,154 65	23.205	
	B-12	3.912	10,569 57	2,701 83	24.057	
	B-14	0.988	2,731 90	2,765 08	27.124	
	B-16	0.227	No cost	reported.		
	B-15	1.080	2,620 00	2,425 92	65.954	Trunk line, double reward.
Total.......	......	45.183	$99,916 20	....	....	
Berrien........	A-9	0.250	$597 00	$2,388 00	10.383	
	B-9	3.641	12,781 07	3,493 82	14.339	
	B-12	0.500	2,136 94	4,273 98	15.208	
	C-9	1.000	4,334 80	4,334 80	17.301	
	D-9	2.375	9,413 90	3,963 74	18.917	
	E-9	26.425	126,403 15	4,787 28	20.888	
	E-10	1.500	10,406 15	6,937 43	15.856	
	E-12	5.264	35,223 79	6,691 45	19.427	
	E-14	1.001	6,824 05	6,817 23	21.996	
	F-9	0.889	6,453 01	7,258 73	13.776	
Total.......	......	42.843	$215,014 07	....	....	
Branch........	B-9	14.888	$30,460 26	$2,045 96	24.438	
	B-16	1.881	6,543 29	3,478 57	24.435	
Total.......	......	16.769	$37,003 55	....	....	
Calhoun.......	B-9	63.275	$114,213 82	$1,805 04	27 743	
	C-16	0.340	2,611 30	7,680 29	16.582	
	E-9	8.446	33,928 89	4,017 15	24.893	
	E-16	0.513	3,150 00	6,140 35	27.682	
	B-16	3.526	10,994 65	3,118 16	54.517	Trunk line, double reward.
Total.......	......	76 100	$164,898 66	....	....	
Cass.............	B-9	22.472	$41,611 58	$1,851 62	27.002	
Total.......	......	22.472	$41,611 58	....	....	

***Rewarded as 9 ft. wide, but built 14-16 ft. wide before extra state reward was allowed on wider roads.**

TABLE NO. 11.

County.	Class and width. Ft.	Miles.	Total cost.	Average cost per mile.	Per cent state reward paid.	Remarks.
Charlevoix.....	B-9	3.491	$6,299 65	$1,804 54	27.699	
	E-9	6.273	23,557 57	3,755 39	26.628	
Total.......	......	9.764	$29,857 22	....	....	
Cheboygan....	B-9	2.576	$7,490 90	$2,907 95	17.194	
	C-9	2.630	7,473 84	2,841 76	26.385	
	D-9	1.515	4,101 00	2,706 93	27.700	
	E-9	8.222	26,020 31	3,164 71	31.598	
Total.......	......	14.943	$45,086 05	....	....	
Clare.........	A-9	1.000	$918 00	$918 00	27.233	
	B-9	13.975	24,462 84	1.750 48	28.563	
Total.......	......	14.975	$25,380 84	....	....	
Clinton.........	B-9	3.010	$5,970 05	$1,983 40	25.209	
Total.......	......	3.010	$5,970 05	....	....	
Crawford......	A-9	2.008	$639 00	$318 22	78.560	
	B-9	9.034	17,922 17	1,983 85	25.203	
	C-9	4.294	17,128 37	3,988 91	18.799	
	E-9	1.000	2,708 75	2,708 75	36.927	
Total.......	......	16.336	$38,398 29	....	....	
Delta.........	*E-9	42.797	$218,586 87	$5,107 52	19.579	
	E-16	0.667	3,914 39	5,866 25	28.970	
Total.......	......	43.464	$222,501 26	....	....	
Dickinson.......	*E-9	15.576	$95,678 25	$6,142 67	21.945	$5,421 T. L. 50% additional on 10.841 miles.
Total.......	......	15.576	95,678 25	....	....	
Eaton...........	B-9	61.171	$105,534 78	$1,725 21	28.982	
Total.......	......	61.171	$105,534 78	....	....	
Emmet.......	B-9	10.696	$40,226 60	$3,761 75	14.788	$501 T. L. 50% additional on 2.003 miles.
	D-9	0.142	Included	above.		
	E-9	10.575	43,835 04	4,145 16	26.223	$920 T. L. 50% additional on 1.843 miles.
Total.......	......	21.413	$84,061 64	....	....	
Genesee.......	A-9	0.678	$1,246 00	$1,837 76	13.563	
	B-9	79.107	203,927 76	2,577 87	19.395	
	C-9	14.007	59,140 18	4,221 58	21.369	$2,121 T. L. 50% additional on 5.655 miles.
	D-9	5.328	24,616 96	4,620 30	19.405	$781 T. L. 50% additional on 2.084 miles.
	E-9	11.401	59,068 93	5,181 03	20.359	$625 T. L. 50% additional on 1.250 miles.
Total.......	......	110.521	$347,999 83	....	....	
Gladwin.........	B-9	0.500	$779 70	$1,559 40	32.063	
Total.......	......	0.500	779 70	....	....	
Gogebic.......	*B-9	3.578	$17,549 00	$4,904 69	10.194	
	*E-9	3.060	31,194 31	10,194 22	13.752	$1,530 T. L. 50% additional on 3.060 miles.
Total.......	......	6.638	$48,743 31	....	....	
Grand Traverse	A-9	0.920	$4,172 16	$4,534 95	5.512	
	*B-9	29.969	84,914 31	2,833 39	19.232	$1,347 T. L. 50% additional on 5.432 miles.
	B-12	5.398	13,910 25	2,577 40	25.219	
	D-9	0.313	586 36	1,873 35	40.035	
	B-14	2.668	18,489 91	6,930 25	21.644	Trunk line, double reward.
Total.......	......	39.268	$122,072 99	....	....	
Gratiot.......	A-9	16.697	$19,524 00	$1,169 45	21.377	
	B-9	102.428	$134,622 52	1,314 30	38.415	$501 T. L. 50% additional on 2.004 miles.
	B-16	1.020	2,316 00	2,270 59	74.870	Trunk line, double reward.
Total.......	......	120.145	$156,462 52	....	....	

*Rewarded as 9 ft. wide, but built 14-16 feet wide before extra state reward was allowed on wider roads.

TABLE NO. 11.

County.	Class and width. Ft.	Miles.	Total cost.	Average cost per mile.	Per cent state reward paid.	Remarks.
Hillsdale......	B-9	25.498	$54,633 56	$2,142 00	23.340	
	E-9	3.807	9,606 20	2,523 29	39.630	
	E-12	0.682	2,200 00	3,225 80	40.300	
Total.......	......	29.987	$66,439 76	....	....	
Houghton.....	*E-9	6.669	$45,132 19	$6,767 46	22.164	$3,334 T. L. 50% additional on 6.669 miles.
	E-15	5.255	43,533 15	8,284 14	38.626	Trunk line, double reward.
Total.......	......	11.924	$88,665 34	....	....	
Huron.........	A-9	3.690	$12,882 97	$3,491 32	7.166	
	B-9	39.740	77,934 32	1,961 10	25.496	
	C-9	4.436	17,685 18	3,986 74	18.812	
	E-9	26.165	101,437 62	3,876 84	25.791	
	F-9	0.500	3,660 48	7,320 96	13.791	
	B-15	1.000	2,700 00	2,700 00	59.259	Trunk line, double reward.
Total.......	......	75.531	$216,300 57	....	....	
Ingham.......	B-9	20.474	$44,226 39	$2,159 80	23.150	
	*E-9	2.000	13,485 17	6,742 58	14.831	
Total.......	......	22.474	$57,711 56	....	....	
Ionia...........	B-9	27.384	$51,340 73	$1,874 22	26.676	
Total.......	......	27.384	$51,340 73	....	....	
Iosco..........	A-9	4.510	$9,336 84	$2,069 33	12.081	
	E-9	5.364	16,807 52	3,133 39	31.879	
Total.......	......	9.874	$26,144 36	....	....	
Iron...........	*B-9	5.416	$33,770 47	$6,235 30	9.786	$597 T. L. 50% additional on 2.386 miles.
	C-16	1.418	12,714 70	8,953 94	28.478	Trunk line, double reward.
	E-16	4.510	38,531 70	8,543 61	39.795	Trunk line, double reward.
Total.......	......	11.344	$85,016 87	....	....	
Isabella.........	B-9	51.986	$89,418 13	$1,720 18	29.066	
Total.......	......	51.986	$89,418 13	....	....	
Jackson.......	A-9	1.000	$969 70	$969 70	25.781	
	B-9	21.784	58,961 52	2,706 64	18.473	
	B-12	1.000	3,651 80	3,651 80	17.799	
	E-9	4.500	16,888 06	3,752 90	26.646	
	C-16	2.268	16,548 41	7,296 47	34.948	Trunk line, double reward.
Total.......	......	30.552	$97,019 49	....	....	
Kalamazoo....	A-9	2.740	$4,337 82	$1,583 14	15.793	
	B-9	64.018	154,588 45	2,414 76	20.759	$2,180 T. L. 50% additional on 8.718 miles.
	B-13	0.198	Cost included	in B-14.		
	B-14	2.012	8,446 89	3,822 12	43.091	
	B-16	0.624	2,761 39	4,425 30	19.192	
	D-9	1.000	4,080 22	4,080 22	18.626	
	E-9	11.301	51,476 36	4,555 02	21.953	
	F-9	0.435	4,376 63	10,061 36	9.938	
	B-16	3.612	14,461 36	4,005 36	42.443	Trunk line, double reward.
	C-16	0.500	3,790 70	7,581 60	33.634	Trunk line, double reward.
Total.......	......	86.440	$248,319 82	....	....	
Kalkaska......	A-9	3.408	$9,850 04	$2,890 56	8.649	
	B-9	24.815	60,634 39	2,443 50	20.468	
	D-9	1.994	7,618 85	3,820 88	19.623	
	E-9	6,570	22,582 25	3,437 18	29.093	
Total.......	......	36.787	$100,685 53	....	....	
Kent..........	B-9	41.721	$101,221 86	$2,426 10	20.609	
	E-9	2.997	9,277 99	3,095 79	32.301	
Total.......	......	44.718	$110,499 85	....	....	

*Rewarded as 9 ft. wide, but built 14-16 feet wide, before extra state reward was allowed on wider roads.

TABLE NO. 11.

County.	Class and width. Ft.	Miles.	Total cost.	Average cost per mile.	Per cent state reward paid.	Remarks.
Keweenaw	*E-9	2.002	$4,754 81	$2,375 03	42.104	
Total		2.002	$4,754 81			
Lake	B-9	10.370	$19,834 31	$1,912 66	26.141	
Total		10.370	$19,834 31			
Lapeer	B-9	16.993	$45,539 80	$2,680 07	18.656	
	C-9	1.000	2,897 40	2,897 40	25.885	
	C-12	0.502	2,118 62	4,245 73	22.939	
Total		18.495	$50,555 82			
Leelanau	B-9	6.666	$14,397 76	$2,158 38	23.128	
Total		6.666	$14,397 76			
Livingston	B-9	39.021	$79,242 08	$2,030 80	25.525	$817 T. L. 50% additional on 3.268 miles.
Total		39.021	$79,242 08			
Luce	D-9	0.999	$4,766 42	$4,766 42	15.702	
Total		0.999	$4,766 42			
Macomb	B-9	3.074	$9,294 79	$3,023 67	16.536	
	C-12	0.468	2,416 33	5,163 09	18.871	
	C-14	1.376	9,371 51	6,810 62	16.518	
	E-9	2.000	12,178 40	6,089 20	16.422	
	C-16	3.933	33,672 79	8,561 60	29.786	Trunk line, double reward.
Total		10.851	$66,933 82			
Manistee	A-9	1.000	$1,922 90	$1,922 90	13.001	
	*B-9	52.195	146,532 68	2,807 51	18.737	$1,360 T. L. 50% Additional on 5.442 miles.
	E-9	2.587	14,646 41	5,661 53	17.663	
Total		55.782	$163,101 99			
Marquette	*E-9	12.040	$82,509 01	$6,852 90	21.602	$5,780 T. L. 50% additional on 11.567 miles.
Total		12.040	$82,509 01			
Mason	A-9	1.000	$986 70	$986 70	25.337	
	B-9	35.227	81,839 33	2,323 26	21.521	
	D-9	0.500	1,256 25	2,512 50	29.850	
	E-9	13.972	52,448 55	3,753 83	26.639	
Total		50.699	$136,530 83			
Mecosta	B-9	60.680	$120,830 68	$1,974 79	25.109	
Total		60.680	$120,830 68			
Menominee	B-9	19.488	$23,897 98	$1,226 35	40.756	
	E-9	7.393	21,401 45	2,894 82	34.544	
	C-9	8.800	23,487 61	2,669 04	28.099	
Total		35.681	$68,787 04			
Midland	A-9	1.000	$943 50	$943 50	26.497	
	B-9	5.460	9,080 98	1,663 00	30.066	
Total		6.460	$10,024 48			
Missaukee	B-9	11.304	$22,720 84	$2,009 98	24.875	
	C-9	8.265	26,799 60	3,242 56	23.136	
	E-9	1.045	3,836 00	3,670 71	27.242	
Total		20.614	$53,356 44			
Monroe	E-9	25.383	$105,236 10	$4,145 92	24.120	
	E-14	3.004	24,451 02	8,139 48	18.429	
Total		28.387	$129,687 12			

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*Rewarded as 9 ft. wide, but built 14-16 feet wide, before extra state reward was allowed on wider roads.

TABLE NO. 11.

County.	Class and width. Ft.	Miles.	Total cost.	Average cost per mile.	Per cent state reward paid.	Remarks.
Montcalm.....	A-9	2.089	$3,808 69	$1,823 21	13.712	
	B-9	59.075	104,561 66	1,770 01	28.240	
	B-10	1.552	2,283 50	1,471 32	37.381	
Total.......	......	62.716	$110,653 85	....	....	
Muskegon.....	A-9	2.016	$3,867 54	$1,918 42	13.031	
	B-9	17.854	64,619 30	3,619 30	13.825	
	C-9	0.931	6,352 54	6,823 35	10.991	
	E-9	38.748	164,339 30	4,241 23	27.705	$6,783 T. L. 50% additional on 13.567 miles.
	B-16	0.663	6,636 26	10,009 44	16.984	Trunk line, double reward.
	E-16	0.255	1.580 34	6,197 41	54.925	Trunk line, double reward.
Total.......	......	60.467	$247,395 06	....	....	
Newaygo......	B-9	24.673	$50,419 77	$2,043 52	24.467	
	E-9	8.745	40,218 80	4,599 06	21.765	
***Total**.......	......	33.418	$90,638 57	....	....	
Oakland.......	B-9	23.159	$56,201 34	$2,426 65	21.727	$641 T. L. 50% additional on 2.564 miles.
	B-11	0.500	1.267 50	2.535 00	23.668	
	*D-9	1.000	10,470 93	10,470 93	7.162	
	E-9	2.004	6,569 40	3,278 14	30.505	
Total.......	......	26.663	$74,509 17	....	....	
Oceana........	B-9	11.435	$21,568 75	$1,886 20	26.509	
	E-9	49.450	192,099 18	3,882 69	26.777	$1,990 T. L. 50% additional on 3.980 miles.
Total.......	......	60.885	$213,667 93	....	....	
Ogemaw.........	B-9	5.056	$8,359 58	$1,653 39	30.240	
Total.......	......	5.056	$8,359 58	....	....	
Ontonagon.......	E-9	2.566	$11,650 00	$4,540 14	22.026	
Total.......	......	2.566	$11,650 00	....	....	
Osceola.......	B-9	27.337	$51.718 46	$1,891 81	27.116	$375 T. L. 50% additional on 1.500 miles.
	C-9	1.000	2,788 24	2,788 24	26.898	
	E-9	4.971	16,769 88	3,373 54	29.642	
Total.......	......	33.308	$71,276 58	....	....	
Ottawa........	B-9	6.116	$14,914 57	$2,438 60	20.490	
	B-12	3.012	11,849 01	3,933 93	16.524	
	E-12	1.000	5,779 00	5,779 00	22.495	
Total.......	......	10.128	$32,542 58	....	....	
Presque Isle.....	B-9	1.020	$1,562 00	$1,531 37	32.650	
Total.......	......	1 020	$1,562 00	....	....	
Roscommon.....	B-9	4.490	$9,390 36	$2,091 39	23.907	
Total.......	......	4.490	$9,390 36	....	....	
Saginaw.......	A-9	2.032	$4,057 00	$1,996 55	12.521	
	B-9	6.321	19,980 57	3,162 55	15.815	
	C-9	1.522	6,001 75	3,943 34	19.019	
	E-9	119.260	618,145 98	5,183 18	19.692	$2,470 T. L. 50% additional on 4.940 miles.
Total.......	......	129.135	$648,185 30	....	....	
Sanilac	B-9	15.090	$24,397 66	$1,533 67	32.601	
	E-9	6.496	21,672 98	3,336 36	29.972	
Total.......	......	22.405	$46,070 64	....	....	
Schoolcraft....	E-9	9.226	$46,067 35	$4,993 21	23.326	$1,520 T. L. 50% additional on 3.040 miles.
	E-12	2.764	12,778 00	4,623 01	56.237	Trunk line, double reward.
Total.......	......	11,990	$58,845 35	....	....	

***Rewarded as 9 ft. wide,** but built 14-16 feet wide, before extra state reward was allowed on wider roads.

TABLE NO. 11.

County.	Class and width. Ft.	Miles.	Total cost.	Average cost per mile.	Per cent state reward paid.	Remarks.
Shiawassee....	A-9	2.494	$2,294 80	$920 13	27.146	
	B-9	35.954	71,146 64	1,978 82	25.267	
	B-10	1.534	3,195 72	2,083 26	26.401	
	B-16	2.002	6,284 67	3,139 19	54.163	Trunk line, double reward.
Total.......	......	41.984	$82,921 83	....	....	
St. Clair.......	B-9	3.740	$5,542 70	$1,482 00	33.738	
	E-9	18.752	84,984 94	4,532 10	22.065	
	F-9	0.506	3,424 17	6,767 13	14.777	
Total.......	......	22.998	$93,951 81	....	....	
St. Joseph.....	A-9	1.000	$1,149 70	$1,149.70	21.745	
	B-9	4.644	12,918 00	2,781 65	17.982	
	E-9	0.500	1,979 44	3,958 88	25.272	
Total.......	......	6.144	$16,037 14	....	....	
Tuscola.......	B-9	69.770	$141,656 13	$2,030 33	24.626	
	C-13	1.000	3,888 77	3,888 77	27.001	
	E-9	1.750	10,875 44	6,214 51	16.001	
Total.......	......	72.520	$156,420 34	....	....	
Van Buren.....	A-9	2.045	$3,682 79	$1,800 88	13.882	
	B-9	17.483	36,653 49	2,096 52	23.849	
	B-16	0.124	Cost inclu	ded above.		
	E-9	5.167	29,274 19	5,665 60	18.470	$250 T. L. 50% additional on 0.500 miles.
	E-16	1.184	9,528 47	8,047 69	42.235	Trunk line, double reward.
Total.......	......	26.003	$79,138 94	....	....	
Washtenaw......	B-9	2.464	$6,018 39	$2,442 52	20.470	
Total.......	......	2.464	$6,018 39	....	....	
Wayne........	B-9	12.118	$48,139 28	$3,972 54	12.586	
	C-9	0.492	2,891 46	5,876 95	12.762	
	C-12	7.542	51,791 17	6,867 02	14.198	
	*E-9	9.984	100,128 49	10,028 89	9.971	
	*F-9	49.804	717,230 71	14,401 06	9.202	$16,183 T. L.. 50% additional on 32.366 miles.
	F-12	5.463	73,809 20	13,510 74	9.622	
	F-15	6.568	146,762 79	16,067 73	16.886	T. L. double reward paid on 3.532 miles of F-15 and 2.566 miles of F-16.
	F-16	2.566				
Total.......	......	94.537	$1,140,753 10	....	....	
Wexford......	B-9	52.026	$133,248 67	$2,560 94	19.524	
	C-9	5.636	14,317 71	2,540 40	34.740	$747 T. L. 50% additional on 1.972 miles.
	D-9	3.014	8,060 67	2,673 52	28.053	
	E-9	2.015	8,404 35	4,170 89	23.976	
Total.......	......	62.691	$164,031 40	....	....	

*Rewarded as 9 ft. wide. but built 14-16 feet wide, before extra state reward was allowed on wider roads.

COST DATA ON ENGINEERING EXPENSES.

TRUNK LINE ROAD SURVEYS.

In order to determine the cost of making surveys for trunk line roads in various counties, this department has kept an accurate card record of cost of each survey which is posted weekly from daily reports made by each employee.

This cost card shows separately,

- Field Cost:
  - Wages paid.
  - Traveling expenses.
- Office Cost:
  - Wages paid.
  - Materials used.

No allowance is made in the cost keeping for office rent, heat, light, lost time, profit, etc., which would have to be added in order to compare fairly with engineers' cost in private business.

The table printed herewith shows these costs tabulated from cards by counties in which work was done. The average cost of surveys throughout the whole State was $41.60 per mile, which includes travel from and to Lansing, stakes used, wages of engineer and all helpers, notebooks, tracing cloth, wages of draftsman, and blue prints sent out in triplicate.

To check these card costs we have compared them with the total expenditure for surveys, plans and maps shown on page 14 of the report, which is $19,824.22. Dividing this by the number of miles surveyed during that period, 300 approximately, we get $66.04 per mile, exceeding the cost shown by the cards by $24.44, which is explained by the fact that during the winter months, draftsmen were employed in drawing county road maps of the whole State, current drawing and filing takes nearly one man's whole time, furniture and surveying instruments amounting to $777.24 are charged out against the survey cost.

The usual engineer in private practice figures on a reasonable profit over and above actual cost. In turn it can be said that the profit to the State this year in making surveys on trunk line roads is represented chiefly by the furniture and surveying instruments secured, county maps made and current drafting work done.

The average cost of construction of all classes of Trunk Line road is seldom less than $5,000 per mile, which would make the average cost of surveys less than 1 per cent of the cost of construction.

Table No. 12, Showing Engineering Costs on Trunk Line Highways Based on Surveys and Plans Completed June 30, 1914.

County.	No. miles surveyed.	Total field cost.	Total office cost.	Total cost.	Average field cost per mile.	Average office cost per mile.	Average total per mile.
Alcona	....	....	....	....	....	....	....
Alger	3.012	$116 50	$34 10	$150 60	$38 67	$11 32	$50 00
Allegan	....	....	....	....	....	....	....
Alpena	3.042	82 98	28 45	111 43	27 27	9 35	36 62
Antrim	....	....	....	....	....	....	....
Arenac	....	....	....	....	....	....	....
Baraga	....	....	....	....	....	....	....
Barry	....	....	....	....	....	....	....
Bay	2.995	127 81	28 16	155 97	46 51	11 86	58 37
Benize	7.947	265 47	72 04	337 51	33 43	8 91	42 34
Berrien	8.501	287 50	70 56	358 06	35 76	9 02	44 78
Branch	....	....	....	....	....	....	....
Calhoun	11.464	303 63	105 01	408 64	26 47	8 77	35 24
Cass	....	....	....	....	....	....	....
Charlevoix	2.999	71 72	80 89	152 61	24 20	26 77	50 97
Cheboygan	....	....	....	....	....	....	....
Chippewa	....	....	....	....	....	....	....
Clare	9.179	291 73	59 83	351 56	38 88	8 02	46 90
Clinton	....	....	....	....	....	....	....
Crawford	....	....	....	....	....	....	....
Delta	24.626	901 02	136 24	1,037 26	36 60	5 71	42 31
Dickinson	....	....	....	....	....	....	....
Eaton	....	....	....	....	....	....	....
Emmet	5.051	191 42	93 20	284 62	37 29	18 41	55 70
Genesee	....	....	....	....	....	....	....
Gladwin	....	....	....	....	....	....	....
Gogebic	....	....	....	....	....	....	....
Grand Traverse	6.260	313 72	61 57	375 29	50 40	9 48	59 88
Gratiot	....	....	....	....	....	....	....
Hillsdale	....	....	....	....	....	....	....
Houghton	....	....	....	....	....	....	....
Huron	....	....	....	....	....	....	....
Ingham	9.772	183 56	99 13	282 69	18 78	10 32	29 10
Ionia	4.790	132 54	36 61	169 15	27 67	7 62	35 29
Iosco	7.271	190 72	47 66	238 38	34 49	10 10	44 59
Iron	....	....	....	....	....	....	....
Isabella	3.006	50 40	34 10	84 50	16 76	11 34	28 10
Jackson	25.223	1,206 50	298 70	1,505 20	47 80	13 11	60 91
Kalamazoo	....	....	....	....	....	....	....
Kalkaska	....	....	....	....	....	....	....
Kent	5.018	188 04	40 14	228 18	37 47	7 99	45 46
Keweenaw	....	....	....	....	....	....	....
Lake	....	....	....	....	....	....	....
Lapeer	....	....	....	....	....	....	....
Leelanau	3.040	111 08	43 72	154 80	36 53	14 38	50 91
Lenawee	....	....	....	....	....	....	....
Livingston	1.745	46 72	10 01	56 73	26 77	5 73	32 50
Luce	....	....	....	....	....	....	....
Mackinac	....	....	....	....	....	....	....
Macomb	....	....	....	....	....	....	....
Manistee	6.068	95 07	52 12	147 19	15 68	8 53	24 21
Marquette	....	....	....	....	....	....	....
Mason	....	....	....	....	....	....	....
Mecosta	1.720	71 86	22 76	94 62	41 75	13 23	54 98
Menominee	13.775	356 24	100 18	456 42	27 26	7 05	34 31
Midland	2.972	31 68	17 80	49 48	12 95	7 29	20 24
Missaukee	....	....	....	....	....	....	....
Monroe	....	....	....	....	....	....	....
Montcalm	....	....	....	....	....	....	....
Montmorency	....	....	....	....	....	....	....
Muskegon	7.545	284 40	62 04	346 44	39 97	9 55	49 52
Newaygo	14.499	291 37	126 06	417 43	22 79	8 41	31 20
Oakland	18.903	574 27	186 52	760 79	30 33	10 06	40 39
Oceana	....	....	....	....	....	....	....
Ogemaw	0.993	34 78	7 07	41 85	23 45	4 77	28 22

Table No. 12, Showing Engineering Costs on Trunk Line Highways Based on Surveys and Plans Completed June 30, 1914—Concluded.

County.	No. miles surveyed.	Total field cost.	Total office cost.	Total cost.	Average field cost per mile.	Average office cost per mile.	Average total per mile.
Ontonagon	....	....	....	....	....	....	....
Osceola	14.381	$231 32	$139 45	$370 77	$19 63	$10 84	$30 47
Oscoda	....	....	....	....	....	....	....
Otsego	....	....	....	....	....	....	....
Ottawa	....	....	....	....	....	....	....
Presque Isle	....	....	....	....	....	....	....
Roscommon	....	....	....	....	....	....	....
Saginaw	6.923	234 46	56 96	291 42	33 87	8 60	42 47
Sanilac	12.570	205 30	141 16	346 46	17 26	11 71	28 97
Schoolcraft	....	....	....	....	....	....	....
Shiawassee	7.117	239 67	72 53	312 20	31 96	9 77	41 73
St. Clair	34.325	1,069 47	270 26	1,339 73	30 86	8 36	39 22
St. Joseph	....	....	....	....	....	....	....
Tuscola	....	....	....	....	....	....	....
Van Buren	3.079	132 44	14 40	146 84	43 01	4 69	47 70
Washtenaw	4.815	133 32	42 14	175 46	27 76	8 79	36 55
Wayne	....	....	....	....	....	....	....
Wexford	4.825	253 07	46 34	299 41	46 25	9 71	55 96
Total	299.451	$9,301 78	$2,737 91	$12,039 69	....	....	....
Grand average, field cost per mile	....	....	....	....	....	....	....
Grand average, office cost per mile	....	....	....	....	$31 59	....	....
Grand average, total cost per mile	....	....	....	....	....	$10 01	$41 60

TRUNK LINE BRIDGE PLANS.

Accurate cost of bridge engineering work has been kept, including examination of sites, preparing plans and specifications, advertising, tests of materials, inspection of construction. About $75,000 worth of trunk line bridges were let this last year at an engineering cost of about $7,500 or 10 per cent. Although this is not high, it can be reduced materially as the work goes on, by the standardization of plans. Eighteen different bridges are represented in the $75,000 construction cost, and these bridges are scattered over the whole State from Houghton county down to Wayne county, making travel from job to job expensive.

REPORT OF PRELIMINARY SURVEY OF PRINCIPAL MERIDIAN ROAD.

The following is a report by counties of the principal meridian survey extending from a point 2 miles west of Merrill in Saginaw county, north about 150 miles to a point 4 miles west of Tower in Cheboygan county. The survey was made by L. H. Belknap, an engineer acting under the direction of this Department during the summer of 1913:

BETWEEN JONESFIELD TOWNSHIP, SAGINAW COUNTY AND WHEELER TOWNSHIP, GRATIOT COUNTY.

Of this 5 miles of line traversed, about 2½ miles are sand and the balance clay.

Passed 16 teams going to or from market, 3 buggies and one auto. Also passed 20 houses and one church.

The lands adjoining are only partly improved.

There is no doubt but that the 5 miles would become a main traveled road giving much service to the community, were a good road constructed on this line.

ACROSS MIDLAND COUNTY.

In the 25 miles of line traversed across this country, 19½ miles have a road built on the line and 5½ miles have not. And of this 19½ miles, 14 miles are now a main traveled road. But from the location of improved farms, the entire road would be traveled were it improved in sandy and rough places and built where there are now no roads.

Of the 25 miles, there are 15 miles of sand land and 10 miles of clay adjoining the line. And of this total, there are about 11 miles under some improvements, the good clay being in strips three or four miles wide.

There are 54 houses, 2 schoolhouses and 1 church along the road within a distance of not to exceed 60 rods either side of the meridian.

In traversing the line, 12 farm teams were passed going to or from market and 3 autos.

There will be two new 150 to 170 foot bridges and one new 30 foot bridge to be built.

ACROSS GLADWIN COUNTY.

Of the 25 miles traversed by this line there is now a road extending only 8½ miles and the remaining 16½ miles have not been opened. There are 6½ miles of clay and 18½ miles of sand soils adjoining the line. There are 20 houses along the road. One 60-ft. bridge across Sugar River will have to be constructed. The line from a point two miles north of Winegars to the north county line of Gladwin passes through a very

sandy unimproved section. To the east about two miles there are good farms. The road on the Meridian north to Winegars would open up some good farming lands and would be a part of a main traveled road.

On account of the hills in Ogemaw and Roscommon counties and a bad swamp in the last mile in Gladwin county a detour had to be made starting at corner of Sections 9 and 16, T. 20 N., R. 1 E. On this detour there are 10 houses and the line follows a road.

BETWEEN OGEMAW AND ROSCOMMON COUNTIES AND DETOUR ACROSS PORTION OF OGEMAW COUNTY.

Of the 24 miles of line on the Principal Meridian, there are only about 1½ miles of this line that is a road. There are no improvements of any kind except that four miles along the line are fenced off into ranches and there is one farm. The soil is sandy.

From the corner of the counties, Gladwin, Ogemaw and Roscommon to the Michigan Central Railroad in Towns 23 N., Ranges 1 E. and 1 W., the line may be considered impracticable either from a building standpoint or its use to the community.

Considering it from a construction point, it is hard to estimate the cost without making a careful survey of the road, but of the 14 miles (the length of this stretch) it is rolling and quite hilly throughout the whole distance. Of the hilly portions there are the following grades ranging in length from 300 to 3,000 feet, as follows:

4,000 ft. of 3%
3,800 ft. of 4%
1,100 ft. of 5%
2,600 ft. of 6%
500 ft. of 7%
2,100 ft. of 8%
2,700 ft. of 9%
1,700 ft. of 10%
1,100 ft. of 12%
2,600 ft. of 15%
1,800 ft. of 20%
300 ft. of 30%

That would give us 4 miles of the 14 miles on a side hill with grades from 3 to 30%. Three miles of this total length may be considered level but the balance is rolling, no grades being taken on grades up to 6% unless they were for 500 feet or more in length.

A road on this line would be of absolutely no use to the community who would have it to build.

Because of the above points against a road on the Meridian, I considered a detour starting in Gladwin county and following main traveled road to West Branch and thence west and north from West Branch as noted. The length of this detour is about 21 miles, of which 13 miles is on a road along which there are improved farms. Also, on two miles of this distance there is now being built two miles of hard head macadam road. Along this detour there are 41 houses and 3 school-houses and the city of West Branch to be benefited directly.

BETWEEN OSCODA AND CRAWFORD COUNTIES.

On 23½ miles of this line there is no road, and along which there are no improvements except about 100 acres of land which is under cultivation and three houses. There are many abandoned farms.

The land is level or slightly rolling, except at Creek Crossings and Elk Hills. The soil is sandy.

There will be bridges to be built by the State. One of about 30 ft. span on East Branch of North Branch, and one over main stream of Au Sable River of about 125 ft. span.

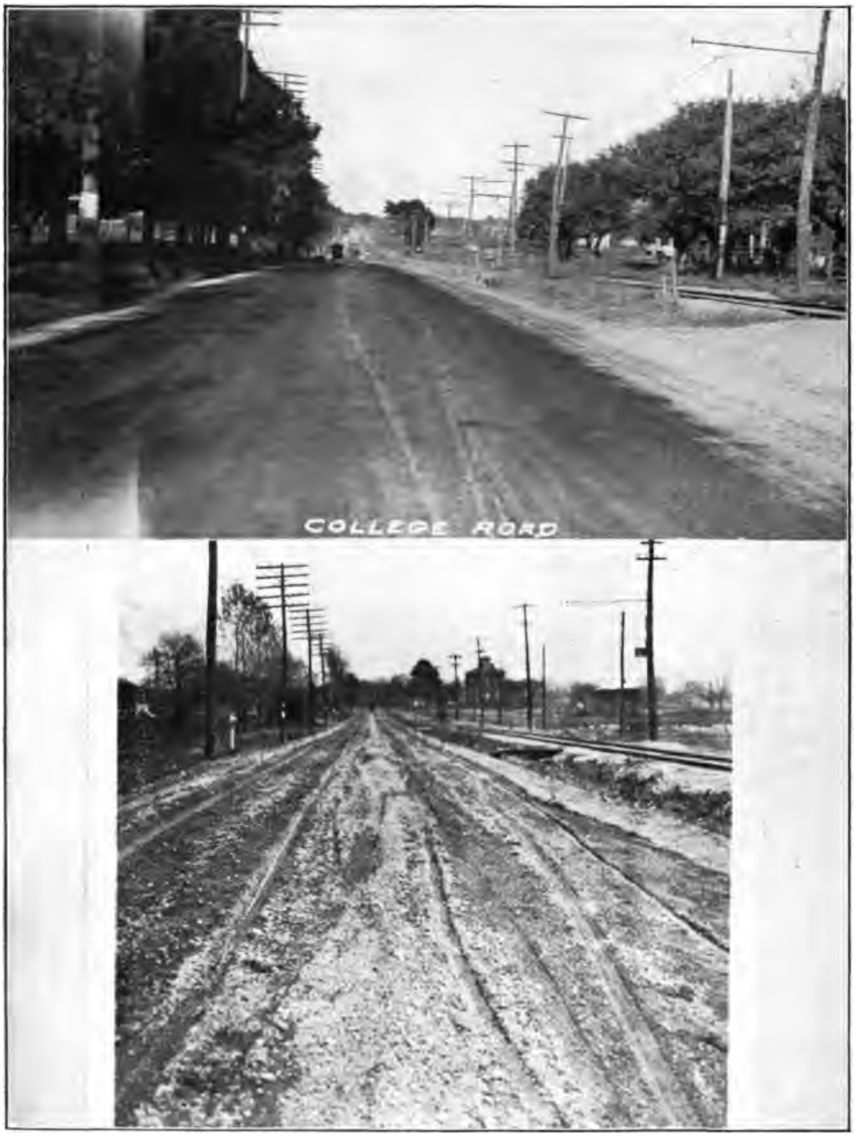
BETWEEN OTSEGO AND MONTMORENCY COUNTIES.

On this 24 miles of line there are 6 miles of road on the Principal Meridian. In three places detours were made. The first detour was made to avoid hills and marshes in Towns 29 and 30 N., Ranges 1 E. and W. This detour passes within a half-mile of Lewiston and goes over a route practically level. Length 14½ miles. The second detour is north of Hetherton about a mile, and was made to avoid deep pockets. Length is about 1⅛ miles. Third detour was made as noted, to avoid four miles of swamp. There are two miles of road on this ⅛ line.

Along the Principal Meridian there are 23 houses, 3 churches, and 1 school-house. From a point a mile south of Vienna to a point a mile north of Hetherton there is good farming lands partly improved.

ACROSS PORTION OF CHEBOYGAN COUNTY.

Of this 11 miles of random there are but two pieces of improvement on the line, but all of the beech and maple lands will make good farms. A detour ought to be investigated to take the place of the last three miles and joint Route 2 west of the Principal Meridian. The east side of Section 13 is too hilly. There is one 30 ft. bridge to be built.



The lower view shows loose gravel on a road between Lansing and the Agricultural College, being constructed by the Ingham County Road Commission. The gravel was put on early in the spring and advantage taken of early rains to float and compact.

The upper view was taken in mid-summer at nearly the same location on the road, showing the gravel thoroughly compacted.

Dark surface caused by recent application of dust preventative and binder.

Table No. 13, Assessed Valuations and Highway Taxes by Counties, 1913.

County.	Assessed valuation.	Road repair tax.	Highway improvement tax.	County road tax.	Total highway taxes.
Alcona	$1,619,177 00	$7,844 40	$13,260 45	$1,012 27	$22,117 12
Alger	4,875,116 00	14,286 65	18,930 31	....	33,216 96
Allegan	40,983,526 00	47,176 78	57,658 80	25,376 89	130,212 47
Alpena	10,350,202 00	6,920 55	8,228 55	20,701 46	35,850 56
Antrim	5,547,043 00	18,207 41	30,166 36	....	48,373 77
Arenac	2,692,862 00	8,094 92	20,486 49	....	28,581 41
Baraga	7,071,401 00	16,026 99	22,719 06	551 17	39,297 22
Barry	14,137,169 00	27,204 29	33,634 70	....	60,838 99
Bay	45,614,943 00	13,675 28	33,281 05	58,331 28	105,287 61
Benzie	4,310,635 00	10,057 41	13,137 26	....	23,194 67
Berrien	59,205,375 00	28,086 16	51,107 71	54,539 84	133,733 71
Branch	18,671,784 00	23,124 28	7,927 09	37,544 25	68,595 62
Calhoun	76,137,427 00	26,738 79	19,559 76	....	46,298 55
Cass	15,217,359 00	26,878 80	24,663 03	30,014 38	81,556 21
Charlevoix	11,269,067 00	10,298 35	10,394 21	22,543 78	43,236 34
Cheboygan	6,852,616 00	16,540 65	19,341 03	18,961 44	54,843 12
Chippewa	12,639,168 00	17,804 64	13,371 96	32,049 09	63,225 69
Clare	4,945,041 00	11,944 69	22,325 19	....	34,269 88
Clinton	19,204,530 00	33,809 35	30,471 57	38,401 85	102,682 77
Crawford	2,530,210 00	4,077 68	8,566 82	....	12,444 50
Delta	9,927,489 00	13,017 75	23,204 55	29,784 23	66,006 53
Dickinson	18,270,262 00	11,645 19	21,611 54	34,995 27	68,252 00
Eaton	23,523,677 00	33,011 54	32,529 09	29,996 88	95,537 51
Emmet	7,868,555 00	13,224 34	17,014 62	23,546 40	53,785 36
Genesee	62,964,854 00	26,265 37	38,908 25	62,961 76	128,135 38
Gladwin	3,261,882 00	10,341 08	17,185 01	9,593 93	37,120 02
Gogebic	50,793,501 00	56,625 75	62,943 09	57,818 93	177,387 77
Grand Traverse	14,160,566 00	11,916 77	23,159 44	18,935 30	54,011 51
Gratiot	16,521,032 00	27,811 21	58,309 21	....	86,120 42
Hillsdale	21,311,971 00	35,944 78	39,384 24	....	75,329 02
Houghton	92,099,199 00	64,319 12	50,131 40	34,010 76	148,461 28
Huron	15,129,082 00	31,515 08	71,159 74	....	102,674 82
Ingham	63,672,415 00	31,358 45	35,761 63	63,764 61	130,884 69
Ionia	20,537,810 00	40,246 43	32,797 06	....	73,043 49
Iosco	4,456,181 00	8,101 21	13,364 74	6,001 79	27,467 74
Iron	35,460,311 00	38,431 15	31,717 37	58,212 49	128,361 01
Isabella	10,254,660 00	20,128 50	41,809 53	....	61,938 03
Jackson	63,117,770 00	32,345 28	24,445 47	....	56,790 75
Kalamazoo	74,731,866 00	20,166 11	16,957 85	74,731 89	111,855 85
Kalkaska	3,591,335 00	9,713 42	11,755 77	10,840 43	32,309 62
Kent	129,898,574 00	50,737 75	66,743 11	....	117,480 86
Keweenaw	11,239,179 00	11,233 60	5,500 00	1,000 00	17,733 60
Lake	1,348,572 00	6,685 48	15,769 05	....	22,454 53
Lapeer	18,202,545 00	30,179 71	30,939 74	36,254 00	97,373 45
Leelanau	3,305,281 00	9,994 83	8,736 84	....	18,731 67
Lenawee	40,249,840 00	39,341 44	54,370 70	....	93,712 14
Livingston	14,637,705 00	26,747 18	37,810 26	....	64,557 44
Luce	4,577,270 00	7,476 14	8,922 30	....	16,398 44
Mackinac	3,909,606 00	12,953 43	16,731 15	....	29,684 58
Macomb	27,431,140 00	22,181 54	34,057 44	54,018 50	110,257 48
Manistee	10,622,422 00	12,407 36	24,420 29	21,356 09	58,183 74
Marquette	64,447,284 00	23,543 18	32,389 54	50,006 95	105,939 67
Mason	7,449,738 00	13,846 09	24,474 21	22,072 92	60,393 22
Mecosta	5,541,215 00	16,966 84	23,633 97	13,573 75	54,174 56
Menominee	11,527,184 00	19,322 99	22,668 55	33,359 75	75,351 29
Midland	7,362,065 00	10,960 42	27,143 48	....	38,103 90
Missaukee	2,290,522 00	8,082 73	18,915 51	9,976 17	36,974 41
Monroe	20,371,725 00	17,991 30	41,787 17	40,075 61	99,854 08
Montcalm	12,344,577 00	26,234 21	39,423 26	....	65,657 47
Montmorency	1,517,568 00	6,744,46	7,615 51	....	14,359 97
Muskegon	20,289,516 00	12,780 79	22,999 69	53,433 78	89,214 26
Newaygo	6,854,089 00	23,413 71	38,811 27	....	62,224 98
Oakland	64,705,695 00	52,417 15	47,037 05	89,207 69	188,661 89
Oceana	6,903,197 00	18,861 86	43,743 35	....	62,605 21
Ogemaw	2,540,945 00	9,075 76	13,166 35	....	22,242 11

Table No. 13, Assessed Valuation and Highway Taxes by Counties, 1913—Concluded.

County.	Assessed valuation.	Road repair tax.	Highway improvement tax.	County road tax.	Total highway taxes.
Ontonagon	$6,584,231 00	$30,425 86	$54,759 17	$17,725 03	$102,910 06
Osceola	5,562,080 00	16,015 79	38,952 60	....	54,968 39
Oscoda	1,196,548 00	4,673 80	1,503 07	....	6,176 87
Otsego	2,924,395 00	7,778 53	14,168 25	....	21,946 78
Ottawa	26,100,841 00	34,985 57	38,982 69	17,482 42	91,450 68
Presque Isle	3,337,873 00	9,211 17	12,005 02	....	21,216 19
Roscommon	1,740,010 00	6,232 44	11,374 09	....	17,606 53
Saginaw	74,313,105 00	23,860 50	88,610 31	88,984 26	201,455 07
Sanilac	15,383,100 00	34,978 65	60,765 67	....	95,744 32
Schoolcraft	5,462,535 00	7,659 23	11,251 58	9,908 47	28,819 28
Shiawassee	21,931,720 00	25,810 81	29,388 68	38,137 94	93,337 43
St. Clair	32,560,850 00	39,284 63	51,694 99	62,833 01	153,812 63
St. Joseph	17,269,221 00	13,810 58	13,350 36	17,271 23	44,432 17
Tuscola	16,783,110 00	32,764 83	70,908 05	....	103,672 88
Van Buren	16,544,085 00	34,282 12	46,266 16	....	80,548 28
Washtenaw	41,339,395 00	38,233 34	23,487 05	74,557 40	136,277 79
Wayne	571,768,050 00	54,388 84	83,518 45	....	137,907 29
Wexford	9,798,037 00	14,963 35	29,586 00	15,224 00	59,773 35
Total	....	$1,824,466 59	$2,511,562 98	$1,621,681 34	$6,757,710 91

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